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Cost of Electric Traction. ELSEWHERE in our columns we give a comparative statement of the relative expense of horse and electric traction as derived from the experience of the West End Street Railway of Boston during the month of June. It needs but little comment and it simply enforces the lesson we drew last week from similar data. In the face of such evidence it seems almost superfluous to do more than forcibly call attention to the facts, leaving for theorists the task of juggling, if they can, with figures to further their own illogical ends. Nowhere in the world has a great commercial experiment been tried with more satisfactory results than by the West End company. If any further suggestion of the desirability of electric traction is needed, it may be found in the experience of one of the steam lines between Minneapolis and St. Paul, where it is proposed to abandon the locomotive service on account of too severe competition with the newer motive power.

Appropriate Garments. WITH this number THE ELECTRICAL WORLD dons a new, patent, adjustable winter-and-summer suit of new type. Our previous one was becoming somewhat well worn, not so much through years of service as through extra hard usage with big editions. We desire to state right here that we were not under the necessity of pawning the discarded one, but having no use for it, no reasonable offer from any of our honored contemporaries is likely to be refused by our printers. We furthermore will engage not to comment adversely on its appearance should we recognize any of our well-worn garments on the back of a somewhat impecunious purchaser. We do not claim to be dudes, and have not yet taken to sporting lurid neckties of the advertising description, but we do have a reasonable pride in presenting a neat appearance week in and week out.

Incandescent Lamp Manufacture. LAST week Judge Wallace granted a stay of proceedings in the decree for an injunction against the United States Electric Lighting Company pending a final decision of the Circuit Court of Appeals. Manufacture by that company will therefore be continued, a bond of $50,000 having been executed to cover any damages from infringements in the interim. The accounting ordered will go on. The outcome of the appeal remains to be seen, but, whatever it is, it will probably terminate the long litigation and settle the rights or lack of rights in the case. Meanwhile, every one is awaiting with interest the action of the directors of the Edison General Electric Company touching the relations of that organization to the various lamp manufacturers. It is hoped and believed that an impartial policy will be pursued such as will encourage the development of the incandescent lamp and render impossible the total suspension of manufacture by any disaster or strike at the Edison Lamp Works.

Permanent Magnets. ON another page we present some useful facts regarding the nature and properties of permanent magnets, from the pen of Prof. S. P. Thompson, whose work on electromagnets was recently published in these columns. The present paper forms a valuable addition to the one just mentioned, taking up, as it does, the permanent magnet from the practical standpoint. Very many questions arise in the mind of one who undertakes to make a magnet for any practical purpose. Not only must the method of magnetization be settled upon, but the quality of steel, the method of tempering, the effect of annealing, and even the lapse of time, all must be taken into consideration. As a matter of fact, a good permanent magnet is by no means easy to construct; for not only is proper steel somewhat difficult to obtain, but its appropriate temper depends not alone on its composition and the magnetization it is expected to carry, but, also, on the very dimensions of the bar itself. For all these reasons a practical discussion of the topic at the hands of one so well versed in its details is particularly convenient for reference.

Priority in Rotary Current Motors. A COMMUNICATION from Mr. A. du Bois-Reymond in the current issue raises again the question of priority between Mr. Tesla and Mr. Ferraris with respect to the type of motor the principles of which have been described by both of them. We must confess our inability to see the justice of ascribing a monopoly of the principle to the latter investigator. His Italian monograph undoubtedly appeared before Mr. Tesla's patent was issued, but long after the application had been filed in the United States Patent Office and passed on by the examiners. Judging from Mr. Du Bois-Reymond's own criterion we are compelled to take the view that Mr. Tesla's application constitutes a prior description, even although it was not fully open to the public. It stands in much the same relation to Mr. Ferraris' paper as it would had it been a sealed communication to the French Academy of Sciences, or some similar scientific body, instead of a direct application for a patent. Such a communication, though formally made public after the appearance of similar matter elsewhere, would certainly form a sufficient reason for claiming the discovery, and *a fortiori* a patent application formally attested and officially inspected should give the same right; especially since the work of Ferraris had become by no means well known before the actual publication of the Tesla patent. Mr. Tesla's patents were actually applied for in the October preceding the publication of Mr. Ferraris' work in March, 1888, and dropping out of sight the commercial questions involved, five months' priority in filing a complete description of the principles, methods and apparatus constitutes a legitimate ground for claiming the first announcement of the scientific principles involved.

A Fine Telephone Building. IN another column we describe the splendid plant just completed by the New England Telephone and Telegraph Company in Boston. No better evidence is needed that the present telephone companies are here to stay, whatever happens to the Bell patents. The possession of franchises and equipment such as this in any large city is pretty nearly equivalent to a monopoly of the business; at least competition after 1893 will be under considerable difficulties. Few people realize the magnitude and complication of a great telephone exchange, or have any adequate idea of the engineering skill necessary to bring it to its present state of perfection. Nevertheless, telephony is by no means an unimportant branch of modern electrical engineering; and although experts in this line are not in the habit of blowing their own horns very loudly, nor announcing sensational discoveries, they have been going quietly along minding their own business and doing most effective work in the improvement of telephone service. Especially is this true with reference to the long distance work, now destined to become more familiar than ever before. Indeed it is not at all improbable that a year or two hence the value of what has been accomplished may be a revelation to the public. Meanwhile the erection of magnificent exchanges, like that in Boston, is a guarantee of the intention of the local telephone companies to spare no pains in giving efficient service to their subscribers as well as to render competition after the expiration of the telephone patents not only ineffectual but needless. In fact it is quite probable that the most immediate effect of free telephones will be not on central plants but on private and mutual systems which have been in the past vigorously discouraged by the course adopted by the Bell Telephone Company. The most important general change is likely to be the universal adoption of double metallic circuits, and the active steps now taken in this direction show that the present companies do not intend to be in the least behindhand in making this improvement.

The Accumulator Decision. ON other pages we give in full the opinion of Judge Coxe in the accumulator case. The storage battery has been the subject during the last decade of continued and vigorous litigation that has in no small measure hindered its development and cramped its usefulness. The present is the second substantial victory scored by the Brush Electric Company in the course of its suits; the earlier one being the decision against the Julien company rendered by Judge Coxe a little over a year ago. The point at issue from the beginning has been the validity of the patents granted to Charles F. Brush for improvements in secondary batteries. The essential feature of Brush's invention was the mechanical application of oxides of lead to a supporting grid of conducting material in contradistinction from the old method of electrical forming introduced by Planté many years ago. A protracted interference in behalf of Faure, the French inventor of the modern accumulator, was decided in favor of Brush, whose invention antedated his rival's French application for a patent. It was on this broad and all-embracing claim that suit was brought against the Julien company. The issue of this action is well known to our readers, and of the remaining litigations the one just decided against the Accumulator company alone was of any thing like a formidable character. The case against the Julien company involved, substantially, the same questions as the present one, but inasmuch as it was compromised by the securing of a license before the opinion was rendered, the decision was less important than the present one. The essential points decided by Judge Coxe in favor of the Brush patents are the following: (1) That Mr. Brush was the first in this country to hold absorptive substance in the form of dry powder in place on the supports of a secondary battery by paper or equivalent material, and the first who rammed or pressed it into grooves or receptacles in the plates, and (2) that this important claim was not invalidated by the expiration of the patent issued to Brush in Italy Sept. 30, 1882, on an application dated July 28 of the same year. This latter question is perhaps the most important one of the number raised in the present suit. The patent aforesaid expired by limitation three years after its issue, never having been prolonged, renewed or extended. The result of the interference with Faure was such as to give a very strong presumption in favor of Brush's priority, and consequently to decide the case in his favor provided his patent was valid. The claims actually present in the Brush patents are very complicated and of a somewhat confused description, but cleared of their verbiage the broad principle is the one just mentioned. If the Italian patent had covered the same essential invention its expiration would have overthrown everything important in the Brush claims. In the present case expert testimony was taken on this point; its character was, as usual, very varied, as well it might have been considering the rather verbose character of the patents. The burden of proof was, of course, on the defendants, and it is Judge Coxe's opinion that forfeiture of the patent has not been plainly shown; he confesses that his mind is still in doubt on the question, but strongly inclined to the opinion that the two patents do not cover the same invention. Consequently his only logical course was to sustain the patent, leaving any more exhaustive discussion of the claims of forfeiture to the Circuit Court of Appeals. The case will of course be carried to this higher tribunal. The Brush company by the decision is entitled to a decree for an injunction without costs, an accounting having been waived. The final decision in this case will probably not be very long delayed and will tend to clear the air somewhat in regard to the use of the accumulator, and will at least permit inventors to know just what rights are involved in the construction of the lead storage battery. Up to the present comparatively little has been accomplished in the way of producing a thoroughly practical accumulator, and it is earnestly to be hoped that having obtained strong legal backing the manufacturers under the Brush patents will push ahead and justify the value of Mr. Brush's claims by important results.

Latest Foreign Electrical News.

(By cable from our own correspondent.)

London, July 27, 1891.—On July 16 Willoughby Smith, the veteran cable engineer, terminated his long and useful career in death. Since 1850 he has been constantly connected with the manufacture and laying of submarine cables. At the date mentioned the Gutta-Percha Company, in which for many years he was prominent, began experimenting with a view of covering wire with gutta-percha for telegraphic and similar purposes. In 1849–50 Mr. Smith was engaged in the manufacture and establishment of a 30-mile cable from Dover to Calais. The experience gained in this work turned his attention to improvements in submarine cables, and in the cable laid over the same line in 1851 he introduced a system of making an insulating joint that proved very successful. Four years later he had brought the methods of connecting and insulating submarine cables to a high degree of perfection, and during the intervening years had laid a number of short and successful lines. In 1854 he began his important work on the Mediterranean. He then had charge of the electrical department during the manufacture of a cable that was afterward laid between Spezzia and Corsica and from Corsica to Sardinia, and assisted Prof. Wheatstone in his important experiments on the retardation of signals through submarine wires. On his return from this Mediterranean expedition Mr. Smith was stationed at the Gutta-Percha Works as electrician and manager of the wire department, and began making preparations for the manufacture of 2,500 miles of core for the Atlantic cable. In 1858 he devised an insulating adhesive compound for sheathing cables previous to the application of successive layers of gutta-percha, and this substance is in general use at the present time instead of the coal-tar naphtha that had previously been used and which proved destructive to the gutta-percha. In 1865 he accompanied the Great Eastern in laying the cable of that year, and devised a system of insulation tests which have since proved very valuable in continuously examining the insulation of the cable as it is paid out. In 1866 he was appointed chief electrician to the Telegraph Construction and Maintenance Company, the successor of the Gutta-Percha Company, and was engaged on board the Great Eastern, during the laying of the first successful Atlantic cable. In 1869 he again accompanied the Great Eastern on the trip that resulted in the laying of the French Atlantic cable. Not long afterwards he devised a very valuable method of reducing the specific inductive capacity of gutta-percha, enabling the speed of transmitting signals through cables to be correspondingly increased. He was a member from the very beginning of the Institution of Electrical Engineers, and has communicated to it a large number of important papers, principally on the subject of submarine and underground telegraphs. To his labors much of the present effectiveness of submarine telegraphy is due, and in his death the scientific world has suffered a severe loss.

The delegates from the Columbian Exposition are now in England and have been received by the Society of Arts and the Chamber of Commerce, and are busily engaged in furthering the interests of the great exposition, in which work they have met with cordial encouragement.

Lord Salisbury has just appointed a committee to investigate matters connected with the London telephone service.

Another municipal plant is under way. The Huddersfield authorities have accepted the tender of the Brush company for the lighting plant they have been for some time contemplating.

Carl Hering, the special correspondent of The Electrical World at the Frankfort Exposition, wires to-day that the display is an exceedingly attractive one to the general public, but, as yet, not of so great importance for electricians and engineers as it will be in the near future. The principal interesting feature now is the very considerable display of the transmission of power by alternating currents. The attendance so far is rather meagre.

NEW BOOK.

Primary Batteries. By Prof. H. S. Carhart. Pp. 193; 67 ills. Boston: Allyn & Bacon, 1891. Price $1.50.

A good practical book on primary batteries has long been a desideratum. The only available treatise for American readers has been a translation of Niaudet's treatise, which, although quite complete, is somewhat heterogeneous, and contains references to very many cells never seen or heard of by the ordinary student or electrician. The present little volume by Prof. Carhart is admirably practical and contains descriptions of nearly all the cells that are met in everyday use; for most of them the chemical reactions are given and several of the types are described in great detail. A valuable addition to the usefulness of the treatise is the chapter on battery tests, and also the special discussion of batteries intended as standards of electromotive force. There are few weak points in the book to be criticised; one of them is somewhat exasperating to the practical man who desires the facts about depolarizing solutions, and does not care to be informed in a general way that a certain cell (figured and described) uses "one of the best substitutes for nitric acid." What the average reader desires to know is, what said substitute is. Secret depolarizing solutions—usually, by the way, either nitric acid or potassium bichromate in disguise—have no place whatever in a treatise intended to give information. Aside from a few minor faults of this sort Prof. Carhart's book will be found a very useful compendium of the theory and practice of the primary battery.

Priority in Rotary Current Motors.

BY A. DU BOIS-REYMOND.

With a feeling of lively satisfaction I note that you have seen fit to reproduce my paper on rotary current in No. 26, vol. 17, of your esteemed journal, and I consider myself greatly flattered by the kind words of recommendation with which, in your leaderette, you invite your readers to peruse my work. But, on the other hand, I cannot help taking the liberty to state that I consider your criticism of my way of treating the priority question as unjust. I dare say you are aware that the question of who deserves the credit of being the only original inventor of electromagnetic rotation is at present being ventilated with great ardor among the technical public all over Europe. I have followed all publications on this important subject from the beginning with great interest, though personally I have had no share whatever in the really original work done up to date. I therefore feel justified in considering myself as an outsider who can lay claim to the ability of forming an unbiased opinion.

Now I personally hold that disputes on priority as far as they do not purely relate to the business side of the question only tend to pervert the historical truth. If A and B nearly simultaneously discover a new truth, why is A to be more honored by mankind than B because he conceived his first glimmering of the new idea while walking to his office on the morning of the nth, while B only hit upon the same line of thought while smoking at his fireside after dinner of the (n + i) th? We ought simply to state what A did, and what B did, and to erect statues to both in their respective native villages. But if it comes to using their names as technical terms for the new invention, one must decide which to use, and in that case I think there is no other possibility than to find out who was the first to publish, patent, or otherwise make known to reliable witnesses, if not the public at large, his new idea. Maybe Mr. Tesla was in the field every bit as early as Mr. Ferraris, but by some chance or other which may be and most likely is neither the fault nor the merit of either, considering that there were at the time a few thousand miles of land and sea between them, Mr. Ferraris published about six weeks before Mr. Tesla. Moreover, Mr. Ferraris published a treatise exposing theoretically nearly all the principles underlying the new system, while Mr. Tesla published a paper mainly describing a more or less practical motor founded on the same principles and only gave a short exposition of a part of the said principles to make his meaning clearer to his audience. Therefore, according to the accepted rule of such formalities I consider myself justified in talking of the "Ferraris principle" and of the "Tesla motor," because everybody who is acquainted with the scientific etiquette knows perfectly well that by this mode of expression I do not offer incense to the one and contempt to the other, but simply mean that according to my knowledge of history the one has been the first to *publish* the principles and the other the first to patent the motor. You might contend that in order to construct a motor a man must be master of its principles and not vice versa; therefore Mr. Tesla by publicly describing his motor has proved that he possessed the principles before Mr. Ferraris' publication. This I will freely admit, though such a contention is certainly open to controversy; but then that would only be one reason more to hold up Mr. Ferraris' merit beside Mr. Tesla's, because even the most ferocious Teslaite must allow that there is merit worth mentioning in having published the said principles. Now, by talking of the Tesla motor we do not detract in the least from Mr. Tesla's merit, because having constructed his motor everybody will credit him with understanding the underlying principles, and everybody who is acquainted with the chronology of the case will easily infer that he must have evolved those principles without the help of Mr. Ferraris' publication, which could hardly have reached him before he filed his first patent. On the other hand, if we would neglect to mention Mr. Ferraris as the first publisher of the said principles, we would ignore his merit altogether.

I must apologize for having suffered myself to be drawn out to such length by your casual remark, but considering the great interest brought forward in re priority of electromagnetic rotation in this country, I hope I may find indulgence.

The Patton Electric Car.

During the past three years many street-car officials have inspected the motor car devised by Mr. W. H. Patton, which he has gradually improved and simplified until it is now almost automatic in its operation. The experimental car which has been in daily service at Pullman, Ill., has attained a speed of 11 miles an hour while drawing a loaded trailer, and is essentially a self-contained equipment, independent of any outside source of power except in the gasoline used as fuel for the dynamo engine, thus doing away with power-house, cable conduit and overhead wires. The apparatus used consists of a vertical 10 h. p. gas engine designed by Mr. Patton to burn gasoline, a 10 h. p. compound wound generator driven by friction, a battery of 100 accumulators and a 15 h. p. single reduction Baxter motor suspended from the front axle. The cells are placed under the seats that extend across the car, and are seldom if ever removed from their position. The gas engine and generator occupy a space of the width of the car by 44 inches in length, relatively the seating capacity of eight passengers where two seats extend across the car. The base of the engine is supported on an iron frame placed six inches above the rails; the muffler extends lengthwise of the car. The engine and generator weigh about 1,500 pounds, and the section of the car containing them is inclosed to the ceiling.

The gasoline is stored in a tank fastened to the ceiling and is fed by gravity to the burner in the engine through flexible rubber tubes, the rate of consumption being one and a half gallons an hour, irrespective of the load, the fluid costing six cents a gallon delivered in Pullman. Thus, to run continuously for 18 hours would require a tank capacity of 27 gallons, or a tank holding 14 gallons to be filled twice a day.

As the gasoline is automatically fed to the engine no special attention is required and only a car operator (and a conductor if necessary) is employed, as the engine continues in operation throughout the day whether the car is in motion or not, and is only stopped when the car is withdrawn from service.

When the engine is in operation the current generated by the dynamo passes to the accumulators if the car is standing, but when the car is in motion the current passes to the motor, both generator and battery being placed in multiple with the motor.

The movement of a simple switch handle controls a pole changer and also cuts in or out the necessary resistance employed. On a level track the motor is supplied with current only from the generator, but on rounding a sharp curve or ascending a heavy grade, where the potential of the generator falls to that of the cells, the latter are automatically placed in circuit and assist in supplying the necessary quantity of current to enable the motor to perform its work. Thus on an ordinary track the cells would only be in service about one-sixth of the time the car was on duty, and there would always be a sufficient supply of current in the cells to run the car for two hours or more independent of engine and generator.

The car at Pullman, which is practically the first car built, and which does not contain the apparatus in as compact and serviceable a shape as will the new car now under construction, has made an excellent record in drawing a loaded trailer, as above mentioned, and in starting and stopping as smoothly as could be desired.

The field in which this motor car can play a prominent part is too well known to require a reference. It may be of service in the small towns, where the cars run "at will;" in the smaller cities, where short competing lines practically prohibit the outlay for cable system or electric power house and overhead equipment; and in the larger cities, where the trolley will not be tolerated.

The officers of the Patton Electric Car Company are: Mr. A. B. Pullman, president; Mr. H. H. Latham, vice-president, and Mr. W. H. Patton, superintendent, all of whom are Chicago gentlemen.

Electric Light Plant on the Steamship Normannia.

BY CARL HERING.

Although there is naturally considerable similarity in the electric lighting plants on board the large steamers, there are at the same time differences in the arrangements, details, etc., which are often instructive to persons interested in such plants.

The steamer Normannia is one of the four new express steamers of the Hamburg line which have been making such fast time between New York and Southampton, and it is the sister ship to the Fürst Bismarck, which holds the record, though only a few hours ahead of the Normannia. The plant was installed by the firm of Siemens & Halske, of Berlin, somewhat over a year ago, and is probably a good illustration of German practice.

The dynamo room is a small, cramped space on one side of the ship in the rear of one of the two engines, not far from the stern. It is slightly below the water line, in which respect it differs from the plant on the new steamer of the French line, La Tourraine, in which the dynamo room is high above the engines, on the level with the hurricane deck. In the former, the plant might be disabled just at the time it may be needed most, in case of an accident, though when water gets into the dynamo room it is quite likely to put out the fires too, so that it is a question whether the location is of much importance. There is another point, however, which appears to be of more importance. The confined space on the Normannia, as compared with the airy and well ventilated space on La Tourraine, makes it a very hot room for the dynamos. The temperature of the room is probably about 120 to 130 degrees Fahrenheit, and as the dynamos increase probably about 75 to 90 degrees above this, they become quite hot, so much so that flexible canvas funnels are arranged so as to direct a blast of cool air from the top of the ship to those dynamos which are being used.

The plant consists of four upright, compound, condensing engines, not more than about 6 feet high. Each drives a dynamo coupled directly to it. Two are placed across

the ship and two parallel with the keel. There is so little rocking on these large steamers that it seems to be immaterial in which direction the shafts are placed. The engines are 40 h. p. each, making 275 revolutions. Ordinarily the large ship's condensers are used, but there are small supplementary condensers which can be used when the steamer is in the docks. The engines run remarkably smoothly, due probably to the very large and massive bearings. They are oiled from small individual tanks, one for each bearing, placed near the top of the machines.

The four direct coupled dynamos are of the well-known Siemens & Halske type, having a Gramme ring revolving outside of the four-poled radial field magnets. Their normal capacity is 35 kilowatts, at 100 volts, each rated at 500 lamps. The four sets of double brushes can all be raised, lowered and moved together. The brushes are made of a roll of fine copper wire gauze pressed into a flat shape, a practice very common on the Continent. They run quite noiselessly. The only objection is that fine pieces of wire fray off the ends, which may cause considerable trouble if they get caught between the commutator bars; the brushes therefore, must be watched and trimmed off at the pointed edge, about twice a day. The starting of a second dynamo in multiple arc is somewhat awkward and unsatisfactory, as it requires that the attendant run repeatedly from one throttle valve to the other until the two machines carry like loads, as indicated by their individual ampere meters.

The system is a simple multiple arc, using the ship as a return. This appears to be the usual practice, although it is attended by the difficulty of having to make so many contacts with the iron at the different lamps. Those that were visible were made with a screw tapped into the iron plates and beams. Contrary to the method on La Tourraine, the grounded line is fused at the dynamo before being connected to the hull. There are about 1,000 lamps on board, all of which are used at night; during the day the load is about 300 to 400 lamps. The reserve power is therefore 100 per cent., as two of the dynamos will do all the work. They are run alternately, each being used about 24 to 36 hours at a time. The lamps are mostly 25 c. p., with a few 16 c. p. In the saloons there are double circuits, one of which is an all-night circuit having one lamp in each saloon; all the rest are on one switch. In the cabins there are two three-point switches, one at the entrance and one at the bed, controlling the one lamp; this is a great convenience, but it complicates the wiring materially, as much of this is in molding secured to the iron plates, often over rivet heads. The practice seems to be to have not more than five lights to a tap, in the saloons, from common mains; the switchboard is therefore quite simple, not as in La Tourraine, where most of the circuits are controlled at the switchboard instead of near the lamps themselves.

In the saloons the lamp bulbs are all frosted, which is a good way of avoiding the use of shades, which would necessarily rattle unceasingly. The decorative fixtures are all made with tubes bent in the form of scrolls, thus avoiding all angles and sharp corners. This form of decoration is quite in keeping with the prevailing style, which is a mass of heavy gilt scrolls of very old design. Contrary to the customs on some other steamers, the ship's lights on the masts and at the sides are also electric lights. The leads to these are in lead cables. The terminals of the lights on the decks are arranged so that they can be closed with a waterproof screw plug in case of very stormy seas. There seems to be great reliance placed on the electric lights, as the reserve oil lamps and candle holders do not look as if they would be ready for use

The New Quarters of the New England Telephone and Telegraph Company.

The removal of the telephone exchange or operating departments of the New England Telephone and Telegraph Company to the splendid new building of the American Bell Telephone Company, corner of Milk and Oliver streets in Boston, occurred on July 11 at 3 P. M.

Before describing the telephone apparatus in the new exchange some idea will be given of the building of the American Bell Telephone Company, which occupies a lot measuring 90 feet on Milk street by 100 feet on Oliver street, and which is one of the most substantial and well built structures in New England. The building is nine stories high, with an additional story of smaller dimensions than those below, all of which latter are high studded and well laid out.

FIG. 1.—A CORNER OF THE MULTIPLE SWITCHBOARD, AND THE MONITOR'S DESK.

The telephone building is constructed of brown brick and Scotch brown sandstone, and is of fireproof construction throughout. Of the nine stories, the lower five will be rented for business purposes. Upon the sixth are the executive offices of the American Bell Telephone Company, as well as the treasurer's office and the office of the legal department. Upon the seventh floor are the offices of the electrical and patent departments, the archives, and the offices of the auditing and statistical departments. The eighth floor is occupied by the business offices of the New England Telephone and Telegraph Company, consisting of the general executive offices, the office of the Boston division, the treasurer's department and the offices of electrician, engineers and the auditor and secretary. The ninth story, and the small tenth story already mentioned, are entirely occupied by the operating department. The corridor floors are all laid in mosaic, and the dado work is of the finest polished marble.

The basement contains the heating and ventilating apparatus, the dynamos for the electric lights with which the entire building is equipped, and the elevator machinery, besides affording storage room for the supplies of the Telephone company. The electric light plant is one of the most compact and complete of its kind to be found anywhere. The steam plant, from which the power is derived, consists of a battery of two Whittier Machine Company's boilers of 55 h. p. each. There are two high speed Ide engines of 70 and 40 h. p. respectively, and two Western Electric Company's incandescent light dynamos, one with a capacity of generating current for 500 lights, and the other for 800 lights.

The switchboard connected with the lighting service of the building is a remarkably elegant one, the back being of dark variegated marble, on which are located the switches connecting the different floors, and the ammeters and voltmeters used on the different circuits.

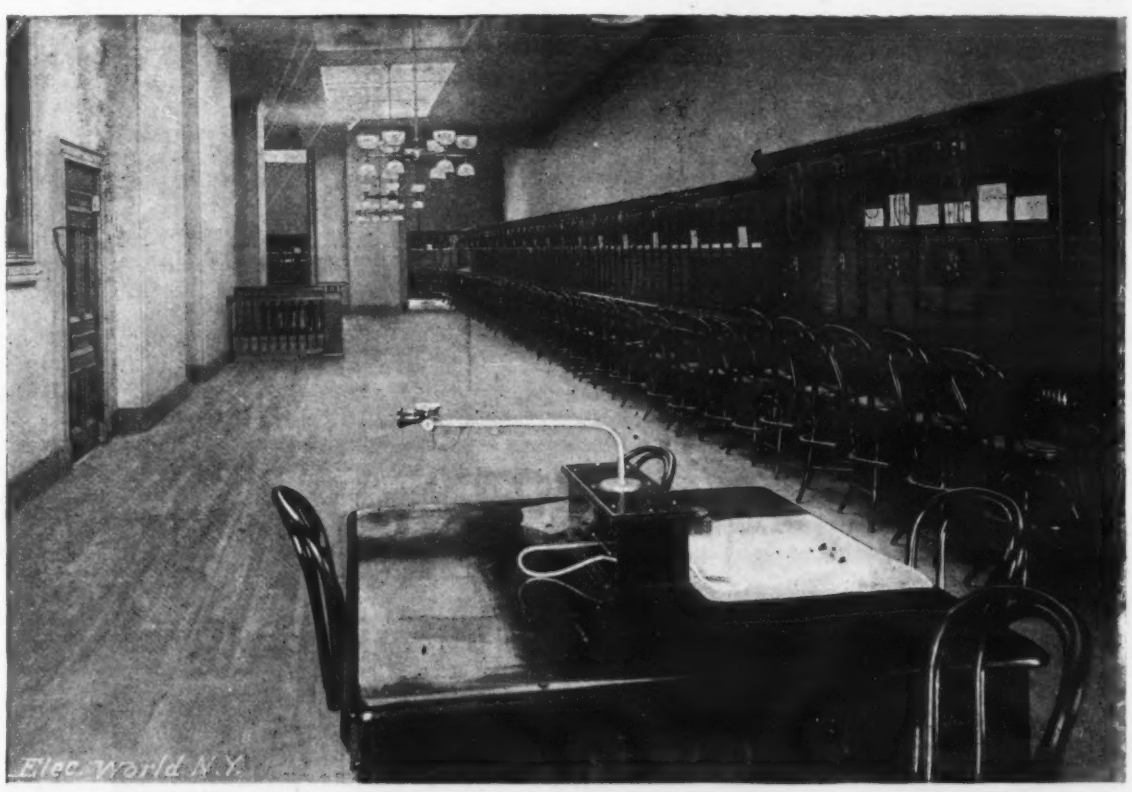

FIG. 2.—MULTIPLE SWITCHBOARD OF THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY.

The ninth floor of the building, as has been already said, is entirely given over to the operating department. The cables carrying the lines come from the ducts in the street up through the shaft provided especially for them in the body of the building, and enter the distributing room, part running through ducts in the cells near the floor to the lower row of cable heads, and part through ducts in the ceiling to the upper row of cable heads. They are so arranged that they do not cross each other in any part of their course, so that any cable may be removed and replaced without disturbing any other cable. The cable heads are in two rows—an upper and lower one—mounted on an iron framework placed a few feet from the walls of the room, so that the cable heads and the protectors may be accessible from both the front and the back. Each conductor in the cable ends in a binding post insulated from the iron of the cable head. From each binding post an okonite covered wire runs to a Hayes combination strong current protector, which protects the switch apparatus from both strong and "sneak" currents. From the protector each circuit passes through a cable under the flooring to the outer terminals of the distributing or cross board, which is of the latest pattern, built of iron rods and tubing and arranged so that in one division the wires shall be carried in a vertical direction, and in a second division behind the first so that they shall be carried in a horizontal one.

The distributing board has an ultimate capacity of 6,000 pairs, and is provided with a platform under which the wires come from the cable heads and run to the switchboards. At present the board is not wired to its full capacity, the terminals at one end being used for wires leading to ex-territorial apparatus, and at the other for wires leading to the local subscriber's apparatus, the space in the middle being left for growth. To the inner terminal of the distributing board are connected the conductors running to the switchboards.

In describing the switchboards it will be best to begin at the extreme right and describe the board in regular order to the extreme left. On the extreme right is a test and combination loop board, with a capacity of 1,020 telephone wires and 102 combination loops. The test board is for the purpose of locating troubles, testing lines and for interchanging lines. At the board the circuit manager, provided with telegraph and telephone instruments and galvanometer and rheostat, tests every line every morning, and gives orders to his men and the different managers to fix trouble located by him in their territory. The combination loop board is for the purpose of handling combination loops. Next to the combination board is placed the intermediate switchboard, having an ultimate capacity of 150 pairs of wires for long-distance subscribers, and 90 local trunk lines for connecting ex-territorial boards together. The eight ex-territorial boards are situated on the other side of the alcove. At these boards the ex-territorial long-distance work is carried on. The regular multiple board, situated on the east and north side of the room, takes the local subscribers', grounded and metallic, and the suburban trunk lines. The board is made to grow from right to left, and is built with an ultimate capacity of 6,000 subscribers' lines and several

hundred trunk lines, and is at present wired for 3,000 subscribers' and 500 trunk lines. It is at this board that all the local exchange and suburban trunk line connections are made, and that the local subscribers are connected to the long-distance board for ex-territorial business.

On the extreme right of this board is the ex-territorial switching section, provided with an end section on each side for the convenience of the operators on the regular sections. There are four operators on this section; one connects the subscriber on the multiple boards to the ex-territorial boards, two connect the ex-territorial boards to the regular multiple subscribers' board, and the fourth operator makes connections between suburban trunks.

Next in order is the trunk section, where all the suburban trunk lines end. These lines first pass through the board, and then come back to the trunk section to the drops and end in a double cord. There are three sections of trunk lines, a hundred lines to a section and three operators to a section. At the left of the trunk sections are the 15 subscribers' sections, with three operators to a section and 80 subscribers to an operator. From each operator's telephone set a circuit runs to the monitor's desk, who may listen to ascertain if any impoliteness is being shown either to or by a subscriber. The express board, situated across the end of the room on the extreme left, is for handling the express business. This express service is peculiar to Boston. There are 600 subscribers for this service, which consists only of calling expresses. No connections are made. The subscriber simply gives the order to the operator through a hand telephone. The operator puts the order on a slip and hands the slip across the board to the sending side. The operators on the sending side sort the slips and call up the different express companies and deliver the orders.

The drops on the regular multiple board are all placed in a trough to economize space, and the board is provided with an intermediate distributing board for interchanging the circuits between the multiple and the answering jacks. The drops in the intermediate board, the ex-territorial board and the express board are on the face of the board.

The battery and generator rooms are in the tenth story, a half story to which the freight elevator runs. Three hundred cells of gravity battery will be placed in these rooms for the circuit manager's instruments and the busy test. The transmitters on the board will all get their battery power from a four-cell accumulator which takes the place of 250 gravity cells. This accumulator is charged by a special dynamo run by a motor which gets its power from the regular lighting circuits. The 12 metallic circuit generators are run by the same motor that drives the accumulator dynamo. The generator circuits are prepared with a switchboard or mains, of which the circuits are interchanged and manipulated with perfect ease. The battery circuits to the different operators' sets are provided with fuses to protect the instruments from possible overcharge of accumulators.

Fig. 2 shows the multiple board and chief operator's desk. Fig. 1 shows the corner of the multiple board and monitor's desk. Fig. 3 the back of the board, showing the cabling and iron and wood supports, the back of the cord shelf and the intermediate distributing board. The photographs were made by Mr. Wm. Vandelip, of the Engineering Department of the New England Telephone and Telegraph Company.

One of the peculiar features of the underground section of the telephone building is the conduit and cable system employed by the New England Telephone and Telegraph Company, to reach out and bring the general public into communication with each other. Under the sidewalks, and on the Milk street side, under the street for several feet, are open passageways through which the cables that come in from conduits in the street pass on their way to the upright shaft at the south end of the building, through which they reach the operating room on the ninth story.

From the Milk street conduit there are 50 ducts that enter the subway, each duct capable of accommodating a cable carrying 120 wires. At the corner of Milk and Oliver streets what is known as the State street conduit enters the subway. This has 27 ducts for cables. On the Oliver street side, near the south end of the building, the Oliver street conduits are reached. These have 70 ducts, of like cable capacity with the others.

The subway is lined on either side and overhead with iron racks, on which are hung brackets to support the cables entering the building from the various conduits. Not only this, but under the concrete flooring of the subways there are a number of ducts which are employed for the same purpose. All the cables received into this subway are carried to or converge into the cable shaft at the south end of the building. This shaft is 5 × 10 feet in area, and is carried up from the basement to the ninth story, a distance of over 100 feet, between solid brick walls, where the various wires which are comprised in the cables are connected with the switchboard apparatus of the operating room.

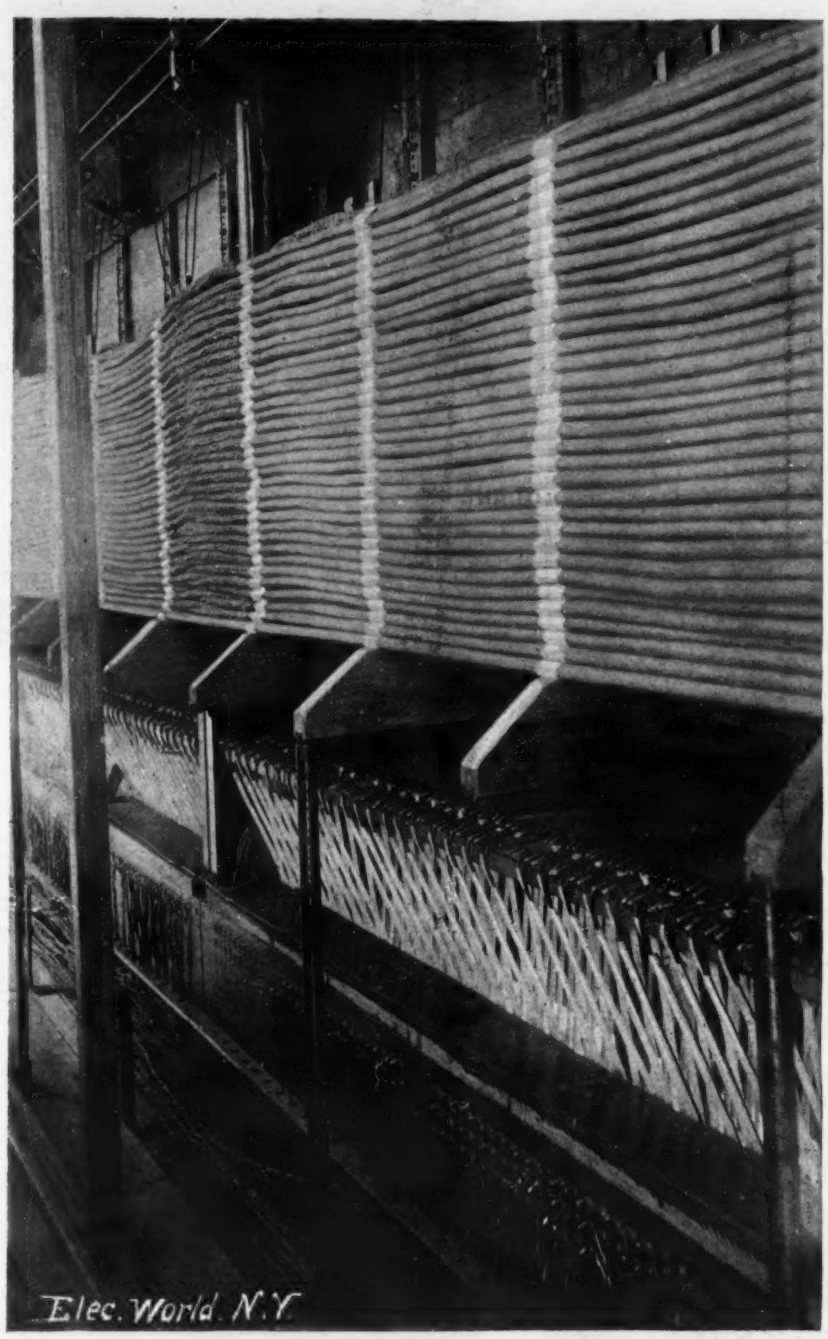

FIG. 3.—BACK VIEW OF SWITCHBOARD.

Though ample provision is made in the conduits for the inevitable growth or enlargement of the telephone business to more than double what it is now, it will give some idea of the extent of the cable system of the company when it is stated that inside the building alone—counting the subway—there are about 30,000 feet of cable which weighs over five pounds to the foot.

This mass of cables and the wires they contain, infinite in number and complicated as they may seem, are all so well arranged and so easily got at that any one cable or any wire in any cable can be removed, replaced or repaired without disturbing the others or disarranging the service of communication in any way, the currents and connection being diverted to other wires and cables for service.

Three competent switchboard inspectors are constantly employed in testing and keeping in order the intricate wire ramifications of the switchboard, the extent and complexity of which can be judged from the fact that the number of soldered wire connections in it is 448,856, and the number of feet of copper wire 14,943,868, or 2,745 miles of wire, all in comparatively short pieces. There are 133,126 distinct moving parts in the switchboard apparatus, and this only includes such separate pieces as are capable of being moved and require to be moved in position in the regular operation of the board.

There is connected with the spacious operating room a resting and lunch room for the operators, which is provided with iron clothes lockers, dining-table, and other conveniences.

The transfer of the telephone service from the old office at 50 Pearl street to the new exchange required 502 miles of wire made up in cables. All this, however, is but temporary, and will only be in use for four or five months, while the permanent underground work of the company is being completed and arranged. The cost of this new apparatus alone will exceed $100,000. This does not include the expense of moving, which is many thousands more.

All the latest improvements and devices for insuring efficiency and rapidity of service have been embodied in the new equipment. The transfer of the operators from the old exchange to the new, and the opening of service from the new switchboard, as already stated, took place July 11, at 3 o'clock P. M.

All the connections having been made with the new apparatus, it was only necessary to sever the connections in the old office and begin the work of answering subscribers' calls upon the new switchboard, a thing that was accomplished in 10 minutes. This change was made with but slight interruption to the service, considering the number of wires moved (between 5,000 and 6,000), and the fact that it required some days of familiarity and actual experience in the manipulation of the new apparatus to become expert in its use.

While the general work connected with the removal of the exchange was carried on under the supervision of General Manager J. M. Keller and his assistant, Mr. W. J. Denver, who has immediate charge of the Boston division of the company's business, the laying out of the routes of the cable conduits and supervision of all the underground work was in charge of Mr. Clarence J. Perkins, the engineer of the company. The details of the electrical work, including the switchboard and its connections, were all made under the direction of Mr. I. H. Farnham, the company's electrician.

The officers of the New England Telephone and Telegraph Company are: Thomas Sherwin, president; Henry S. Hyde, of Springfield, vice-president; S. W. Leedom, auditor and secretary; William R. Driver, treasurer; F. A. Houston, attorney; J. M. Keller, general manager; W. J. Denver, assistant general manager; I. H. Farnham, electrician, and C. A. Perkins, engineer.

In striking contrast to the system in use today is the simple arrangement used in the earliest telephone exchange. In May, 1877, E. T. Holmes, conducting a burglar alarm system at 342 Washington street, Boston, gave an order to Chas. Williams, Jr., 109 Court street, for the manufacture of a switchboard to be used for the temporary union for purposes of oral communication between any two of a number of burglar alarm lines, which were expressly fitted with telephones in order that the exchange system now so well known might be given a fair trial. This was the first switchboard ever made for telephone purposes, and consists simply of a few plates of brass perforated for the reception of plugs, and fitted with binding screws for the reception of the necessary wires.

ORIGINAL TELEPHONE EXCHANGE SWITCH BOARD.
PROPERTY OF E.T. HOLMES.
DESIGNED AND USED BY HIM IN THE
FIRST TELEPHONE EXCHANGE.
BOSTON, MAY, 1877.

FIG. 4.—THE FIRST TELEPHONE EXCHANGE SWITCHBOARD, USED IN BOSTON IN 1877.

As will be seen by reference to the cut three plates were used in the manipulation of each line, the main wire entering the binding post at the top and being connected to the lower right hand plate, which was connected with the burglar alarm system by means of a brass plug. When one subscriber wished to communicate with another he would notify "Central" over the burglar alarm system and the plug would be changed to connect the left hand plate, to which was connected the telephone service. Upon stating who was wanted, "Central" would notify the party and the two lines would be connected across the board by means of a flexible cord with a plug at each end.

To this exchange, which was without doubt the first in the world, there were but five subscribers, as follows: Hide and Leather Bank, Exchange Bank, Shoe and Leather Bank, Brewster, Bassett & Co., now Brewster, Cobb & Estabrook, and Chas. Williams, Jr. At that time Frank M. Moore, now secretary and general manager of the Holmes Electric Protective Company, of Boston, and to whom we are indebted for the photograph from which our cut is made and for information concerning the board, was a boy in the employ of E. T. Holmes, and one of his duties was to attend to this board, so that without dispute Mr. Moore was the first telephone operator in the world. When the success of this was demonstrated the exchange system

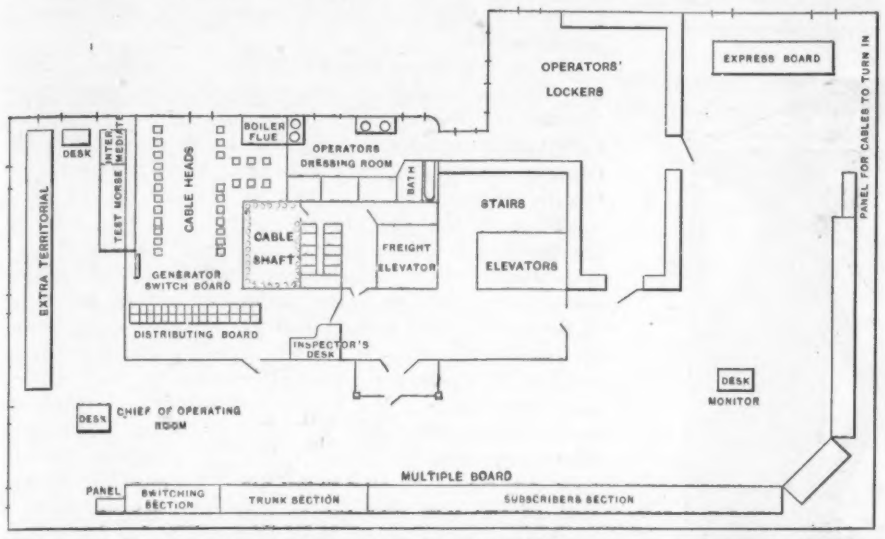

FIG. 5.—PLAN OF THE OPERATING DEPARTMENT OF THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY.

was abandoned for a period and the express call system inaugurated.

To be exact, the first office opened exclusively for exchange purposes was on Brattle street, in Cambridge, but it was not until after the success of the system had been assured with this board. It is to be regretted that the information as to the date of opening this office, the number of subscribers and who the operator was cannot be secured. Shortly after the opening of this office the entire top floor at 342 Washington street was leased, and the Boston Exchange started on a permanent basis. From a few subscribers the Exchange grew so rapidly that in May, 1880, it had outgrown these quarters and was removed to 40 Pearl street, where three floors were leased, the top floor being used for the operating room and the other two for offices, the workshop being located at India square. At this office a Gilliland switchboard capable of accommodating 2,000 subscribers was used; but in January, 1884, this with the entire operating room was badly damaged by fire. This office having reached its capacity it was again decided to move to more commodious quarters, and the entire building at 50 Pearl street was leased, and the office moved therein the latter part of the same year.

For a while it seemed that this building would be the home of the Exchange for all time, but it soon became evident that the Exchange would outgrow even these quarters, and in the spring of 1890 The American Bell Telephone Company purchased the property at the corner of Milk and Oliver streets, and commenced the erection of a large and magnificent building, in which it was determined that there would be room enough for the Exchange with all possible growth. There the Exchange is located to-day, in the quarters and with the elaborate apparatus described above. Just here it might be well to mention that Mr. N. W. Lillie, now the purchasing agent for the New England Telephone and Telegraph Company, and who was the second operator employed by Mr. Holmes, is the only one who was connected with the Exchange at that early period that is yet in the business. Mr. John J. Carty, of the Metropolitan Telephone Company, of New York, so well known by his writings on the subject of telephony, received his early education in the business at this Exchange when it was located at 342 Washington street.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

A. D. 1746.——Nollet (Jean Antoine), a distinguished French philosopher, to whom was given the title of Abbé while holding deacon's orders, is the first in France to make experiments with the Leyden jar.

While in Paris he applied himself to electrical studies in company with Charles Dufay (already noticed at A. D. 1733), and made such ingenious experiments that René de Réaumur allowed him the free use of his extensive apparatus and laboratory. During the month of April, 1746, he transmitted, in the presence of the French King, an electrical shock from a small phial through a chain of 180 of the Royal Guards, and at the Carthusian Convent, not long afterward, he sent a shock through a line of monks stretched a distance of over a mile, causing them all to experience instantaneously the same sensation.

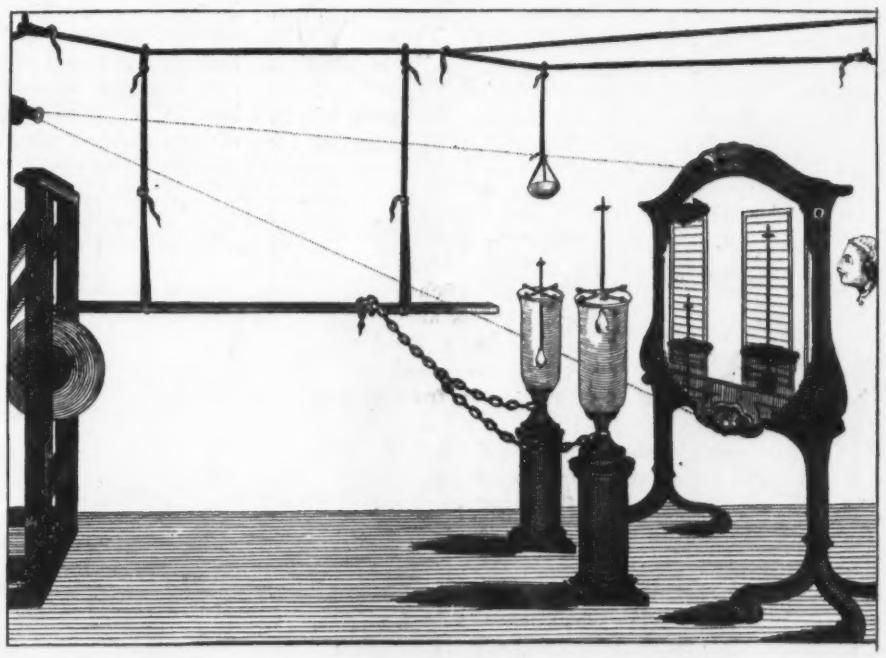
The accompanying illustration represents the machine made for Nollet, and is taken from his work, "Essai sur l'électricité des corps," originally published at Paris in 1750. He was the first to observe that pointed bodies electrified gave out streams of light (the smallest points displaying "brushes of electric light"), but that they do not exhibit as powerful indications of electricity as are shown by blunt bodies. He also observed that glass and other non-conductors are more strongly excited in air than *in vacuo*; that the electric spark is more diffuse and unbroken *in vacuo*; and he also found that an excited tube loses none of its electricity by being placed in the focus of a concave mirror when the sunlight is concentrated in that point.

His experiments upon the evaporation of fluids by electricity, as well as upon the electrification of capillary tubes full of water (observed also by Boze), and upon the electrification of plants and animals, are detailed in his "Recherches, etc.," pp. 327, 351, 354–356. His observation upon the electrical powers of different kinds of glass are to be found in the sixth volume of the "Leçons de Physique Expérimentale."

It is no easy matter to form a very adequate idea of Nollet's theory of electricity, which he obstinately maintained against all the arguments brought forward by his antagonists, in which number may be reckoned almost all the eminent electrical philosophers of Europe. He asserted that when an electric is excited, electricity flows to it from all quarters, and when thus *affluent* (as he termed it) it drives light bodies before it. Hence the reason why excited bodies attract. When the electricity is *effluent* the light bodies are of course driven from the electric, which in that state appears to repel. He conceived every electric to be possessed of two different kinds of pores, one for the emission of the electric matter, and the other for its reception.

Nollet is the first one who published the close relationship existing between lightning and the electric spark. This he did during the year 1748, in the fourth volume of his "Lecons," already alluded to and from which the following is extracted: "If any one should undertake to prove, as a clear consequence of the phenomenon, that thunder is in the hands of nature what electricity is in ours—that those wonders which we dispose at our pleasure are only imitations on a small scale of those grand effects which terrify us, and that both depend on the same mechanical agents, . . . I confess that this idea, well supported, would please me much. . . . The universality of the electric matter, the readiness of its actions, its instrumentality and its activity in giving fire to other bodies, its property of striking bodies, externally and internally, even to their smallest parts, . . . begin to make me believe that one might, by taking electricity for the model, form to one's self, in regard to thunder and lightning, more perfect and more probable ideas than hitherto proposed."

For a memoir treating of the cause of thunder and lightning, written by the Rev. Father de Lozeran du Fech, of Perpignan, the Bordeaux Academy of Sciences had in 1726 awarded him its annual prize; and the same institution was induced to publicly confer a similar award, during August, 1750, upon Mr. Berjeret, a physician of Dijon, whose memoir, though not founded on experimental study, admitted the close analogy between lightning and electricity.



ELECTROMETER DEVISED BY LE ROI AND D'ARCY.

See: "Abrégé des transactions philosophiques," vol. X., p. 336; "Mémoires de mathématique, etc.," pour 1746, p. 22; "Mémoires de l'Acad. des Sciences" pour 1747, p. 24, et pour 1764, p. 409; "Lecons," 8th edition, vol. IV., p. 315; *Phil. Trans.* for 1748, vol. XLV., p. 187, vol. X. abridged, pp. 321, 382–385, 393.

A. D. 1746.——Wilson (Benjamin), secretary to the Royal Society, writes his "Essay toward an explication of the phenomena of Electricity deduced from the ether of Sir Isaac Newton." In the chapter of Priestley's "History" treating of the Theories of Electricity he says: "With some, and particularly Mr. Wilson, the chief agent in all electrical operations is Sir Isaac Newton's ether, which is more or less dense in all bodies in proportion to the smallness of their pores, except that it is much denser in sulphureous and unctuous bodies. To this ether are ascribed the principal phenomena of attraction and repulsion, whereas the light, the smell, and other sensible qualities of the electrical fluid are referred to the grosser particles of bodies, driven from them by the forcible action of this ether. Many phenomena in electricity are also attempted to be explained by means of a subtile medium, at the surface of all bodies, which is the cause of the refraction and reflection of the rays of light, and also resist the entrance and exit of this ether. This medium, he says, extends to a small distance from the body, and is of the same nature with what is called the electric fluid. On the surface of conductors this medium is rare and easily admits the passage of the electric fluid, whereas on the surface of electrics it is dense and resists it. This medium is rarefied by heat, which converts non-conductors into conductors."

At pages 71 and 88, 1746 edition, and at page 88, prop. XI., of the 1752 edition of this same "Essay," Wilson says that during the year 1746 he discovered a method of giving the shock of the Leyden phial to any particular part of the body without affecting any other portion; that he increased the shock from the phial by plunging the latter into water, thereby giving it a coating of water on the outside as high as it was filled on the inside; and that the accumulation of electricity in the Leyden jar is always in proportion to the thinness of the glass, the surface of the glass and that of the non-electrics in contact with the inside and outside thereof.

It was in this same year, 1746, that Wilson first observed the *lateral shock* or *return stroke*, which was not, however, explained until Lord Mahon, third Earl of Stanhope, published his "Principles of Electricity," in 1779.

On the 13th of November, 1760, a paper of Mr. Wilson's was read before the Royal Society, in which he detailed several of his ingenious experiments on the *plus* and *minus* of electricity, and showed that these can be produced at pleasure by carefully attending to the form of bodies, their sudden or gradual removal and the degrees of electrifying. He had previously noticed that when two electrics are rubbed together, the body whose substance is hardest and electric power strongest is always electrified positively and the other negatively. Rubbing the tourmaline and amber together he produced a *plus* electricity on both sides of the stone and a *minus* on the amber; but, rubbing the diamond and the tourmaline, both sides of the tourmaline were electrified *minus* and the diamond *plus*. When insulated silver and glass were rubbed, the silver became *minus* and the glass *plus*.

He further observed that when directing a stream of air against a tourmaline, a pane of glass or a piece of amber, these were electrified *plus* on both sides. Prof. Faraday subsequently showed that no electrical effect is produced in these cases unless the air is either damp or holds dry powders in suspension, the electricity being produced by the friction of particles of water in the one case and by the particles of powder in the other. Sir David Brewster, who thus mentions the latter fact, likewise singles out two more of Mr. Wilson's observations, viz., that when a stick of sealing wax is broken across or when a dry, warm piece of wood is rent asunder, one of the separated surfaces becomes vitreously and the other resinously electrified.

See De La Rive, "Electricity;" vol. I., p. 203, Wilson, "Treatise on Electricity;" Wilson and Hoadley, "Observations on a Series of Electrical Experiments"; *Phil. Trans.*, vol. LI., part I., pp. 308, 331, also part II., p. 896, and vol. LIII., p. 436, etc.; L. I. Koentz, "Lehrbuch der Meteor," Halle, 1832, vol. II., p. 395.

A. D. 1746.——Ellicott (John), of Chester, suggests a method of estimating the exact force of the electric charge contained in the Leyden jar by its power to raise a weight in one scale of a balance while the other scale is held over the electrified body and is pulled to it by its attractive power. This was the principle upon which Mr. Gralath constructed the electrometer, as shown in *Dantzik Memoirs*, vol. I., p. 525.

* Continued from THE ELECTRICAL WORLD, July 25, 1891.

With reference to the experiments of Boze (A. D. 1738) and of Nollet (A. D. 1746) made with capillary tubes, he says that the siphon, though electrified, will only deliver the water by drops if the basin containing the water is also electrified. He endeavors to explain Nollet's observation, that the electric matter issues more sensibly from the point at the extremity of the conductor than if the latter had been made round or flat, by saying that the effluvia, in rushing from the globe along the conductor, as they approach the point are brought nearer together, and therefore are denser there than in any part of the rod. Consequently, he says, if the light be owing to the density and velocity of the effluvia it will be visible at the point and nowhere else. Ellicott's theory of electricity is founded upon the following data: 1, electrical phenomena are produced by effluvia; 2, these effluvia repel each other; 3, they are attracted by all other matter. If we substitute the word *fluid* for effluvia, these data absolutely agree with those subsequently adopted by Acpinus and Cavendish, forming the basis of the only satisfactory theory of electricity hitherto proposed.

See Boulanger, "Traité de la Cause et des phénomènes de l'électricité," Paris, 1750, p. 324; *Phil. Trans.* for 1746, vol. XLIV., p. 96, and for 1748, vol. XLV., p. 195.

A. D. 1747.——Pivati (Johannes Francisco), a Venetian physician, relates in his "Lettere della elettricita medica," that if odorous substances are confined in glass vessels and the latter excited, the odors and other medical virtues will transpire through the glass, infect the atmosphere of the conductor, and communicate the virtue they may possess to all persons in contact therewith; also, that those substances held in the hands of persons electrified will communicate their virtue to them so that medicines can be made to operate without being taken in the usual manner.

This appears to have been likewise asserted by Mr. Verati, of Bologna, and by Mr. Bianchi, of Turin; also by Prof. Winckler, of Leipsic, who satisfied himself of the power of electricity on sulphur, cinnamon, and on balsam of Peru even at a distance.

By the above-named means of applying the electric fluid Pivati is reported to have effected cures of pains and aches, and to have relieved of gout the old Bishop Donadoni, of Sebenico, who had long been a sufferer, and who was at the time 75 years of age. This pretended transudation and its medical effects could not, however, be verified, even with the directions asked of and given by Prof. Winckler, when very careful and exhaustive experiments were made, on the 12th of June, 1751, at the house of Dr. Watson, in presence of the president and other officers as well as friends of the Royal Society. Nor could Dr. Bianchini, professor of medicine at Venice, succeed any better. At a later date, Dr. Franklin asserted that it was impossible to combine the virtues of medicines with the electric fluid.

See Franklin's Letters, p. 82; *Phil. Trans.* for 1748, vol. XLV., pp. 262, 270—for 1750, vol. XLVI., pp. 348, 368—for 1751, vol. XLVII., p. 231—for 1753, vol. XLVIII., pp. 399, 406, and vol. X., abridged, pp. 400–415.

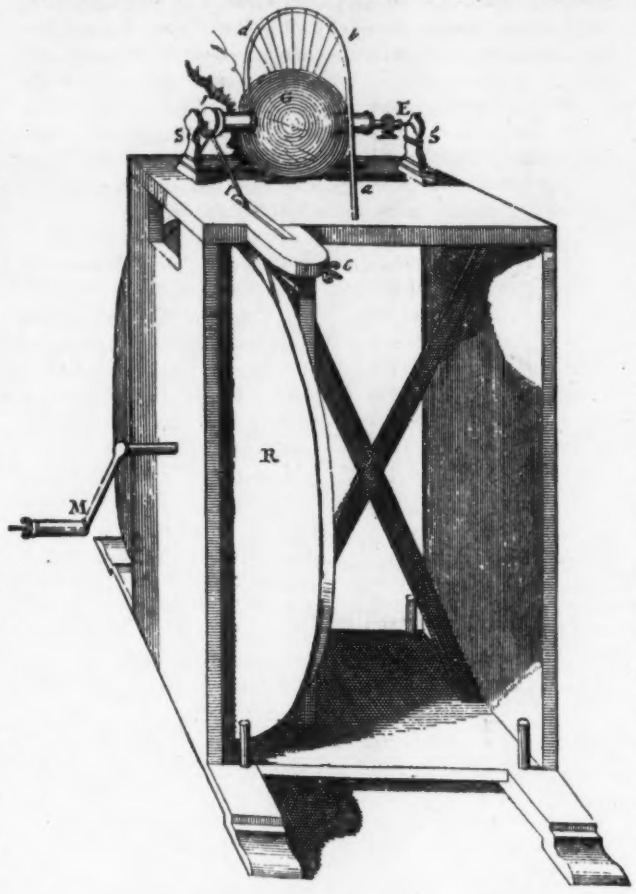
A. D. 1747.——Gralath (Daniel) publishes in the *Dantzig Memoirs* his "Geschichte der Electricitat."

He is the first to construct a Leyden phial with a long, narrow neck, through which is passed an iron wire bearing a tin knob in place of the iron nail heretofore used, and, with several of these phials joined together in the form of a battery, he had, during the previous year, transmitted a shock through a chain of 20 persons. (See Bevis, A. D. 1746.)

His observations are recorded in the above named *Memoirs* at pp. 514 and 516 of vol. I., and at pages 411 and 438-440 of vol. II.

A. D. 1747.——The Swedish mathematician and philosopher, Samuel Klingenstierna, and his pupil, Mr. Stroemer, were the first who properly electrified by the rubber, and their experiments were published in the Acts of the Royal Academy of Sciences at Stockholm for the year 1747. (See Priestley's "History of Electricity," Part 1, Period 8, Section 3, wherein he alludes to Wilcke's "Herrn Franklin's briefe, etc.," p. 112.)

A. D. 1748.——Morin (Jean), French physicist, publishes at Chartres "Nouvelle dissertation sur l'électricité des corps, etc.," in which he details many of his experiments, and endeavors to give a correct explanation of all the extraordinary electrical phenomena hitherto observed. He is also the author of a "Reply to Mr. Nollet upon Electricity," published in 1749 at Chartres and at Paris, as well as of a treatise upon Universal Mechanism, which latter, according to the *Journal des Savants*, contained more information upon Nature generally, and expressed in fewer words, than was embraced in any previous work.



'SGRAVESANDE'S ELECTRICAL MACHINE.

See "Dict. Univ.," vol. XI., p. 568; "Biog. Générale," vol. XXXVI., p. 599.

A. D. 1749.——Stukeley (the Rev. William), M. D., is the first who advanced that earthquakes were probably caused by electricity. This he did in a paper read before the Royal Society, March 22, 1749, having reference to the subterranean disturbances noticed in London Feb. 8 and March 8 of the same year. In this paper, as well as in a subsequent one read to the same Society Dec. 6, 1750, bearing upon a similar disturbance observed throughout England during the previous month of September, he explains why earthquakes are not the result of subterraneous winds, fires, vapors, etc.

One of his strongest arguments is that no such vapors could instantaneously have destroyed 13 great cities as did the earthquake which occurred in Asia Minor, A. D. 17, and which is reckoned to have shaken a cone of earth of 300 miles diameter in base and 200 miles in the axis. This quantity of earth, he says, "all the gunpowder which has ever been made since the invention of it would not have been able to stir, much less any vapors, which could be supposed to be generated so far below the surface," and, he adds, "if the concussion depended upon a subterraneous eruption the shock would precede the noise."

He observes that the earth for months prior to the aforenamed disturbances "must have been in a state of electricity ready for that particular vibration in which electrification exists"; that all the vegetation had been "uncommonly forward . . . and electricity is well known to quicken vegetation"; that the aurora borealis had been very frequent about the same time and had been twice repeated just before the earthquake, "of such colors as had never been seen before," there being, one evening, "a deep red aurora borealis covering the cope of heaven very terrible to behold"; that the whole year had been "remarkable for fire-balls, thunder, lightning and coruscations, almost throughout all England," all which "are rightly judged to proceed from the electrical state of the atmosphere"; and, finally, that, a little before the earthquake, "a large and black cloud suddenly covered the atmosphere, which probably occasioned the shock by the discharge of a shower. . . . Dr. Childrey observes that earthquakes are always preceded by rain and sudden tempests of rain in times of great drought."

Dr. Stephen Hales, who was Stukeley's classmate at Bennet College, Cambridge, becoming his chief assistant in the study of the natural sciences, and who afterward became celebrated for his physical investigations and discoveries, arrives at a like conclusion. He thinks that "the electric appearances were only occasioned by the great agitation which the electric fluid was put into by the shock of so great a mass of the earth." The great noise which attended the disturbance of March 8, 1749, he conjectured was "owing to the rushing or sudden expansion of the electric fluid at the top of St. Martin's spire, where all the electric effluvia, which ascended along the large body of the tower, being strongly condensed, and accelerated at the point of the weather-cock, as they rushed off made so much the louder expansive explosion." It may be added here that Dr. Hales is the one who, at a previous date, had communicated to the Royal Society his observation of the fact that the electric spark proceeding from warm iron is of a bright, light color, while that from warm copper is green, and the color from a warm egg of a light yellow. In his opinion, these experiments appeared to argue that some particles of those different bodies are carried off in the electric flashes, whence those different colors are exhibited.

See Priestley, "History of Electricity," part I., period X., section 12; *Phil. Trans.*, abridged, vol. X., pages 406–526, 535, 540, 541, 551; Thomson, "Hist. Roy. Soc.," 1812, page 197.

A. D. 1749.——Jallabert (Jean), professor of philosophy and mathematics at Geneva, is the author of "Expériences sur l'electricité, avec quelques conjectures sur la cause de ses effets," Paris, 1749.

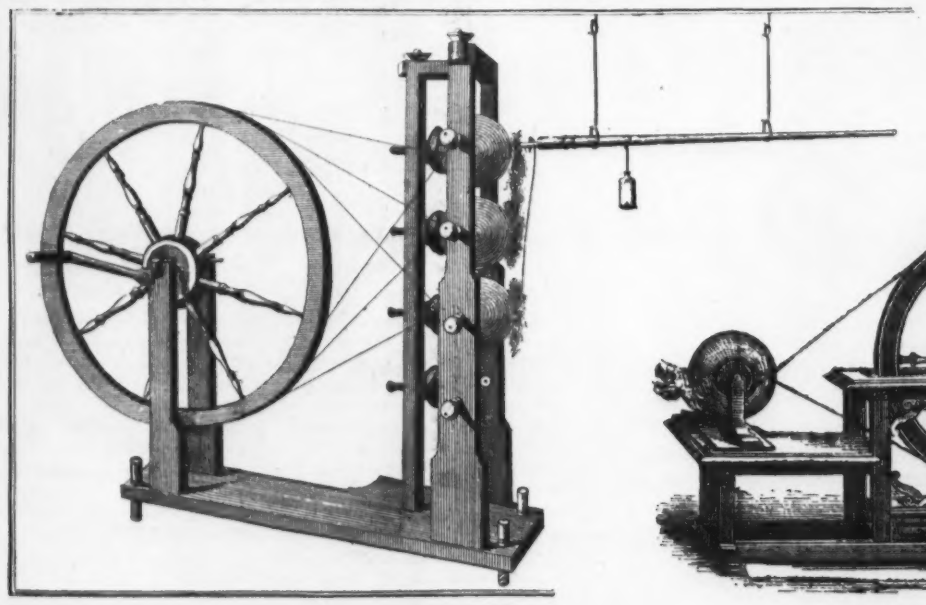
He confirms the result obtained by Dr. Watson (A. D. 1745) that the electric fluid takes the shortest course by passing through the substance of a conducting wire instead of along its surface. By making his Leyden experiments with a jar in which the water is frozen, he shows that ice is a conductor of electricity. He improves upon Nollet's experiments, and demonstrates conclusively that plants which are electrified grow faster and have finer stems, leaves and flowers than those which are not electrified. He was doubtless the first who observed that a body pointed at one end and round at the other produces different appearances upon the same body, according as the pointed or the rounded end is presented to it. The *Dantzik Memoirs*, vol. II., p. 378, tell us that Carolus Augustus Van Bergen, professor of medicine at Frankfort on Oder, had previously observed, "as a small step toward discovering the effect of pointed bodies," that sparks taken from a polished body are stronger than those from a rough one. With the latter he found it difficult to fire spirits, but he could easily do it with a polished conductor.

Mr. Jallabert is also known to have effected some medical cures through the agency of the electric fluid, as related in the "Expériences" above alluded to.

See "Biog. Univ.," vol. XX., p. 535; Bertholon, "Elec. du Corps Humain," 1786, vol. I., pp. 260, 292, 299, 334, 413, and vol. II., p. 291; Beccaria, "Dell' Elettricismo Naturale, etc.," page 125.

A. D. 1749.——Mines are fired by electricity (S. P. Thompson, lecture delivered October 7, 1882, at the University College, Bristol).

A. D. 1749.——Through the important work entitled "Traité sur l'Electricité," Louis Elisabeth de la Vergne Tressau secures, a year later, admission to both the French Académie des Sciences and the English Royal Society.



WATSON'S ELECTRICAL MACHINE.

NOLLET'S ELECTRICAL MACHINE.

WILSON'S ELECTRICAL MACHINE.

During 1786, three years after his death, the above named work was merged into a publication in two volumes under the title of "Essai sur le fluide électrique considéré comme agent universel."

See Biographie Générale, tome 45, pp. 623-626; Larousse, "Dictionnaire Universel," tome 15, p. 474.

A. D. 1749.——Du Hamel (Henri Louis, du Monceau), member of the French Royal Academy of Sciences, develops, in conjunction with Mr. Autheaume, the method introduced by Gowin Knight (A. D. 1746) for making artificial magnets, which latter process was found to be defective when applied to very large bars. To Le Maire, however, is due the essential improvement of placing the bar to be magnetized upon a larger bar and then magnetizing the two together (*Mém. de l'Acad. de Paris*, 1745 and 1750).

The improvement consists in magnetizing at the same time two steel bars of any desired shape by placing them parallel to each other and connecting their extremities, with pieces of soft iron placed at right angles, so as to form a closed rectangular parallelogram. Two strong magnets, or preferably two bunches of small magnetic bars, with their similar poles together, are then applied to the centre of one of the bars to be magnetized and are drawn away from each other, as in Dr. Knight's method, while held at an inclination of about 45 degrees. The operation is repeated upon the other bar and continued alternately until sufficient magnetism is imparted to both, it being borne in mind that before the treatment is given to the second bar the poles must in each instance be reversed, *i. e.*, the pole which was to the right hand should be turned to the left. The whole operation is to be repeated upon the reverse side of both bars.

See Haris, "Rudim. Magn.," I. and II., pp. 85 and 86.

A. D. 1750–1753.——In Mr. Arago's Historical Eloge of James Watt, translated by James P. Muirhead and published in London during the year 1839, it is said, at page 6, that Watt constructed at about the period first mentioned a small electrical (his earliest) machine, the brilliant sparks from which became a subject of much amusement and surprise to all the companions of the poor invalid.

A. D. 1750.——Wargentin (Pierre Guillaume), Secretary to the Swedish Academy of Sciences and a distinguished astronomer, addresses, on the 21st of February, a letter to the Royal Society, of which a copy is to be found in vol. XLVII. of the *Phil. Trans.* In this he gives his observations of the result produced on the magnetic needle by the aurora borealis.

We have already seen (Aurora Borealis, THE ELECTRICAL WORLD, vol. XVII., p. 474) that the discovery of the fact that magnets are affected by the polar lights has been ascribed to Wargentin, and we have also learned (A. D. 1722) that he ascertained the diurnal changes of the magnetic needle with more precision than had been done by George Graham.

See Walker, "Magnetism," p. 116; *American Journal Science and Arts*, 1841, vol. XXX., p. 227; Celsius, A. D. 1740,

Wiring Chart.

BY THOS. J. FAY.

In THE ELECTRICAL WORLD of July 4, 1891, I placed before the public a diagram for determining the heating effect of the electric current in round copper conductors for given loads in ampères. The diagram which I now present is one for determining the length of a round copper conductor which is necessary in order to waste a given number of volts, or percentage of energy, at a given load in ampères. The first diagram is intended for use in proportioning conductors for cross section, while the present one can be employed in proportioning for lengths.

The former is based on the law of heating in connection with continuous currents, while the latter is from Ohm's law, and therefore, in order to apply them for alternating currents, a *percentage* must be allowed for inductive effects.

By the use of the two diagrams combined practically no calculations are necessary; the diagrams are simple and easily understood, while they cover the factors broadly. It will be observed that the sizes of the conductors are given in B. & S. gauge, thereby dispensing with the use of wire tables, heretofore necessary.

The lines crossing the abscissas and ordinates represent ratios between the number of lamps multiplied by the distance in feet, and the percentage of energy wasted, or number of volts lost, while the ratio also represents the sizes of wire.

One is not confined to the voltage specified, because the number of volts wasted may be found, and they represent percentages of any voltage. The same holds good with the lamp columns because the 55-volt column may also be taken as ampères, and by determining the capacity of any other lamp in ampères we may take the 55-volt column for a comparison.

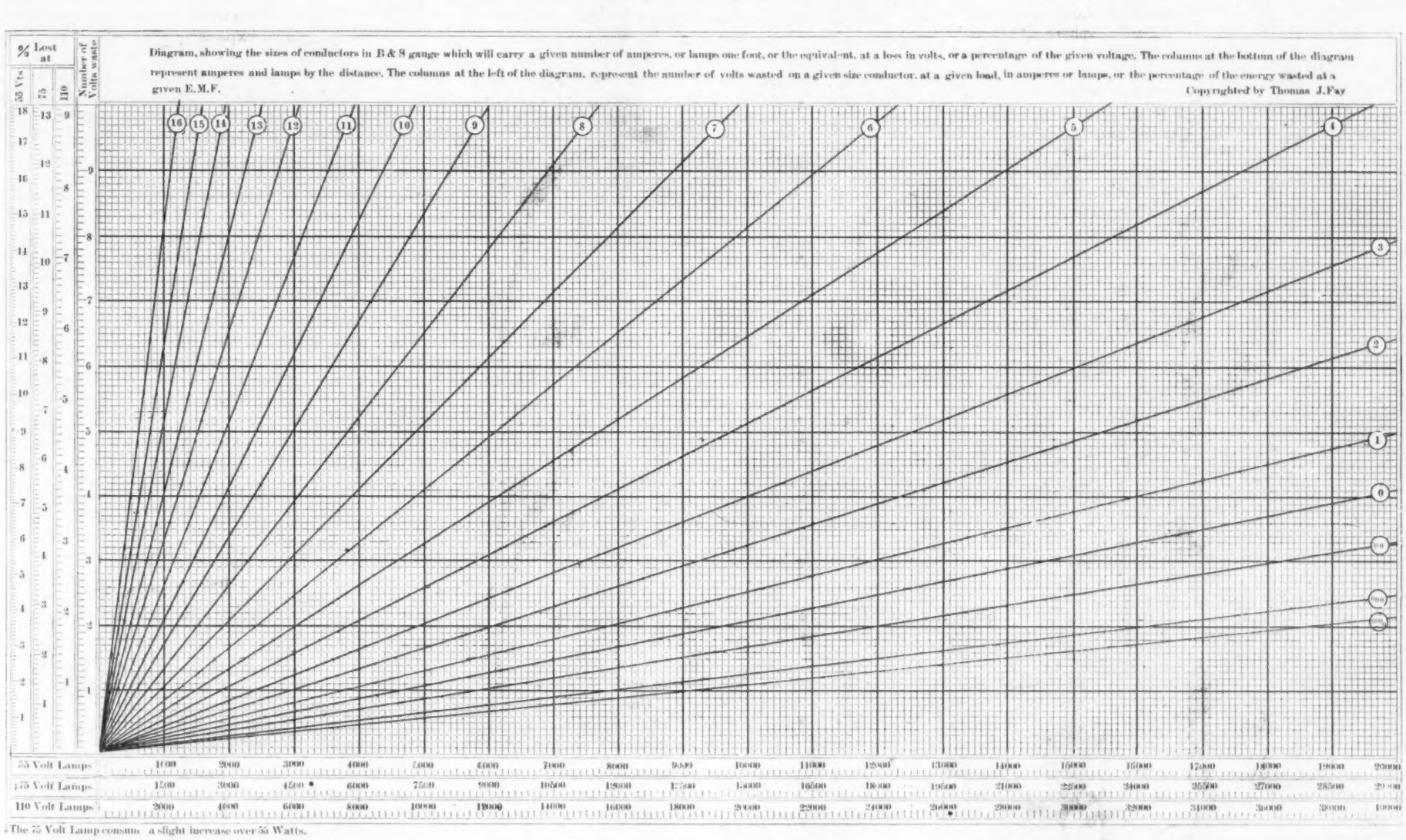
Example.—Find the size of a conductor in B. & S. gauge necessary to carry sixty 55-volt lamps 100 feet at three per cent. loss.

From the diagram we find that the size of the conductor would be represented by a line drawn to intersect the ordinate representing 60 × 100, or 6,000, and the abscissa representing the loss of energy, which is three per cent. No line is drawn at exactly that point, but the nearest one will answer in practice, which is equal to No. 1 B. & S. gauge.

After determining the size of a conductor by the above method it is then necessary to determine from the heat diagram if the conductor is of sufficient cross section to prevent excessive heat.

In that case the problem is to find how much a No. 1 B. & S. gauge wire will heat carrying 60 ampères. By using the diagram as previously explained it will be observed that the wire will heat 18 degrees Fahrenheit, while for ordinary wiring 30 degrees would not be considered too much. It would not be practicable to decrease the size of the conductor because it did not heat 30 degrees, for the reason that a greater percentage of the energy would be wasted on account of the length, as a conductor offers resistance to a current directly proportional to its length, and inversely as its cross sectional area.

The ratios in this diagram are based on the use of 96 degrees pure copper at 75 degrees Fahrenheit, as illustrated in Dr. Matthiessen's experiments. For any increase over 75 degrees Fahrenheit, therefore, 0.21 degree must be added (to the area of the conductor, which would be the required size at 75 degrees Fahrenheit) for each degree Fahrenheit increase.


% Lost at
55 Volts
75
110
Number of Volts waste
Diagram, showing the sizes of conductors in B & S gauge which will carry a given number of amperes, or lamps one foot, or the equivalent, at a loss in volts, or a percentage of the given voltage. The columns at the bottom of the diagram represent amperes and lamps by the distance. The columns at the left of the diagram, represent the number of volts wasted on a given size conductor, at a given load, in amperes or lamps, or the perventage of the energy wasted at a given E.M.F.
Copyrighted by Thomas J.Fay
55 Volt Lamps
75 Volt Lamps
110 Volt Lamps
* The 75 Volt Lamp consum a slight increase over 55 Watts.

FAY'S WIRING DIAGRAM FOR USE IN CALCULATING THE LENGTH OF CONDUCTOR NECESSARY TO GIVE A CERTAIN DROP IN VOLTAGE.

New York City Rapid Transit.

In accordance with its expressed intention the New York Rapid Transit Commission has selected a route for a system of rapid transit to provide passenger transportation facilities to the central and east central sections of New York City, north of Fourteenth street and south of the Harlem River. The route as planned will be similar in construction to that proposed for the west side, described in THE ELECTRICAL WORLD of June 6, 1891, viz., by tunnel from Fourteenth street, where it will connect with the Broadway and west-side route, north to Ninety-sixth street, where it will change to a viaduct and retain this plan of construction to the Harlem River at 134th street.

The report of the commission given out, as adopted by a unanimous vote, is as follows:

Resolved, That this board approves a plan for an underground four track railway diverging from the proposed Broadway line at or near Fourteenth street; thence under Union Square to Fourth avenue, and under Fourth and Park avenues, near and south of Forty-second street; thence by suitable course to the westward under such private property and streets as shall be found practicable to Madison avenue at or near Forty-fourth street; thence under Madison avenue to a point near Ninety-sixth street; thence crossing to the eastward to a point not less than 100 feet east of Madison avenue; thence by viaduct over private property, parallel to and not less than 100 feet east of Madison avenue, to a point near and south of 134th street; thence by curve to the eastward and by bridge across the Harlem River.

Resolved, That the general plan of construction from Broadway to a point near Ninety-sixth street shall be either by double-decked tunnel with two tracks upon each deck, or four tracks on the same level, as may be found upon further examination to be most expedient, and as near the surface as shall be found practicable. From near Ninety-sixth street north to be covered by viaduct with four tracks to Harlem River.

Resolved, That the conditions as to the locations of the stations in the tunnel and all appliances connected therewith shall be substantially the same as those required for the proposed west side line described in resolution of this board approved May 27, 1891. (See THE ELECTRICAL WORLD, June 6, 1891.)

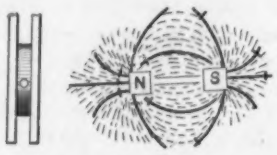
Resolved, That the engineers of this board are hereby directed to make the necessary surveys, plans and specifications for the above described east side line south of the Harlem River at the earliest practicable date, and submit the same promptly to this board in such form and manner as may be necessary to place the same before the Common Council of New York, as required by the Rapid Transit act of January 31, 1891.

Resolved, That from the Harlem River north of the city limits the exact location and mode of construction can only be determined by instrumental survey, and that due regard should be had for the present sparseness of population and necessary economy of construction, and that the engineers be and are hereby instructed to make such surveys at the earliest date practicable, but without delaying the preparation of the plans and specifications for that portion of the line south of the Harlem River.

An Early Dynamo Machine.*

An interesting chapter in the history of the development of the modern dynamo-electric machine is to be found in William Sturgeon's "Scientific Researches," a folio containing 563 pages and 19 copper-plate engravings, printed in 1850 by Thomas Crompton, of Bury, and published by subscription. This interesting work contains a list of 251 subscribers, mostly Lancashire folk. Among the names of the subscribers are to be noticed those of Michael Faraday and James Prescott Joule. In spite of the fact that the work contains a vast amount of electrical research and speculation, Sturgeon evidently looks upon his spindle armature magneto machine, with commutator for setting the currents in one direction (unio-directive discharger), as one of his most important inventions, and in the preface he thus refers to it:

"The magneto-electrical machine, represented by Figs. 1 and 7,† Plate XII., has some years since found its way into the specification of a patent by Mr. Woolrich, of Birmingham, for the purpose of electro-gilding and silvering, notwithstanding my having published the same plan a long time previously, and pointed out its superiority over that in which voltaic batteries are used. The first announcement of my apparatus was in a paper read before the Royal Society, June 16, 1836, in which it was stated that I had coated metals from metallic solutions by means of the magnetic



Figs. 2 and 4.—Sturgeon's Early Dynamo.

electrical apparatus; and in a small work on 'Electro-gilding and Silvering,' published March 1, 1842, I particularly stated the application of the same machine in the process of gilding and silvering in the following words: 'It is now more than seven years since I contrived a magnetic electrical machine that produced continuous electric currents, by means of which I coated metals with tin, copper, etc., and I have employed the same machine to great advantage in silvering, gilding and platinizing various kinds of metal of inferior value, and I have no doubt that in this capacity the magnetic electrical machine will become generally useful.'"

The paper read before the Royal Society (June 16, 1836) is reprinted on page 251 *et seq.* of the work now under notice, and commences by pointing out the general advantages of magnetic machines over batteries. Next comes a description of the spindle armature machine, in which a longitudinal coil revolves between the arms of the magnet.

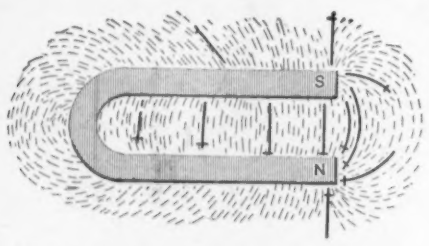
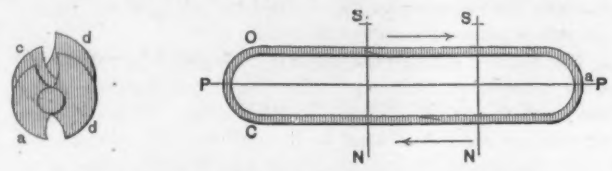


Fig. 3.—Sturgeon's Early Dynamo.

Sturgeon also realized what is generally looked upon as a quite modern discovery, that in this type of armature an iron core may be dispensed with.

Fig. 1 shows the machine with the near limb of the compound horseshoe magnets removed and the armature in section. The following is from Sturgeon's description: "The spindle *i i* passes through the pillar *f* (which supports the wheel *g*), and also through the axis of the reel *k k k k* to which it is fixed. On the reel is coiled 200 feet of copper wire, about one-twentieth inch in diameter, and covered with stout white sewing silk to prevent metallic contact in the coil. The reel which holds the wire is made of two thin pieces of deal, of the shape *k k k k*, which form the cheeks, and are kept at about 1½ inches apart and parallel to each other by the pieces which cross them for the reception of the wire. The extremities of the wire terminate in a discharging arrangement to be described in the sequel." The magnet used was a four-bar horseshoe magnet weighing 23 pounds, the limbs being five inches apart at the poles and about six inches apart near the bend; hence will be seen the reason for the two long sides of the coil not being quite parallel. Fig. 2 represents the core of the armature in end view and shows the hole for the axis. Sturgeon continues: "When the magnet is placed on the stage its plane is parallel to the plane of the base board. The spindle *i i*, which is also parallel to the axis of the base board, is situated in the axis of the magnet. By this arrangement the coil is made to revolve between the branches of the magnet, and electric currents are excited whilst the coil travels through the magnetic lines." Sturgeon now refers to Fig. 6 as representing the wire circuit and Fig. 3 as representing the magnetic field, and at some length traces out the phases of current production, much in the same words as may be met with in the text-book of the present day. He then describes a number of experiments with the machine, and afterward he alludes to a machine with a horseshoe armature and also the one-direction commutator. The structure of the one-direction commutator will be sufficiently obvious from the sketches, small hollows containing mercury fulfilling the functions of the ordinary brushes, and as these obviously have to be horizontal, the commutator must be made double, as shown by Fig. 5, segments *c* and *d* being connected with one end of the wire, while segments *a* and d^1 are connected with the other end. Sturgeon, however, evidently did not confine himself to the commutator with mercurial brushes, as in an appendix (page 275) to the memoir he refers very emphatically to the inconven-



Figs. 5 and 6.—Sturgeon's Early Dynamo.

ience of using mercury, and advocates the use of "discharging pieces or springs, lubricated by sweet oil whilst pressing upon the metallic arcs attached to the revolving spindle," and he says this contrivance was first described by him in the *London and Edinburgh Philosophical Magazine* for September, 1835. In another appendix (page 274) he says: "Mr. Christie, one of the Council of the Royal Society, saw some of these experiments with the spring discharger attached to the machine, at my house, within a week after my paper was read. At that time the machine would liberate one cubic inch of gas from acidulated water in eight minutes, showing an increase of power equal to one-third of that which is exerted with the mercurial polar cells."

Sturgeon's collected account of his researches presents many other points of interest, especially in relation to numerous rotation experiments, both with thermo currents and battery currents, several of these touching on matters which have scarcely found place in modern text-books; and some of the most interesting relate to the rotation of a magnet about its axis when the magnet itself carries the actuating current, an arrangement which gives us the simplest electric motor or dynamo known, armature and field being one. Such an arrangement is referred to (as generator) in Mrs. Mary Somerville's "Connection of the Physical Sciences," second edition, London, 1835, page 361, who says: "When a magnet revolves uniformly about its own axis, electricity of the same kind is collected at its poles, and the opposite electricity at its equator." The experimental proof of this is quite easy, if a round bar of steel is carefully centered on a quick-running lathe and light tin-foil brushes are used. It is worth mentioning that one modern book at least deals with this simple form of dynamo, as in Prof. Oliver Lodge's "Modern Views of Electricity," Macmillan, 1889, page 146, we have a drawing of the dynamo in question—see Fig. 7.

In reference to the dynamo represented above, Professor Lodge says: "Spinning the magnet mechanically gives a

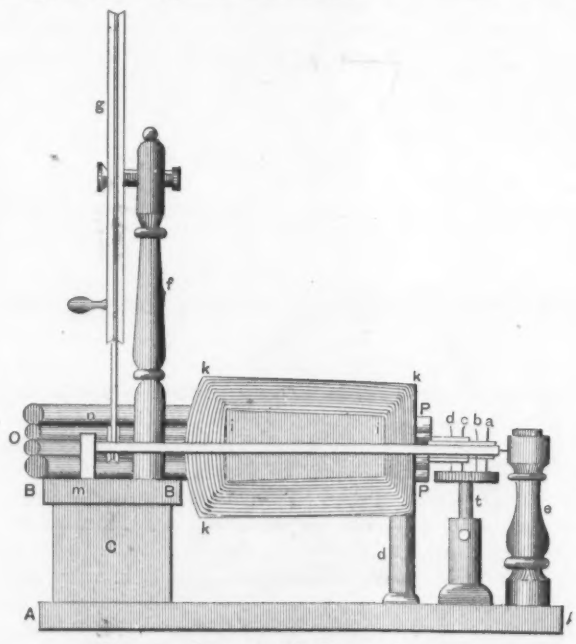


Fig. 1.—Sturgeon's Early Dynamo.

current between two springs, one touching it near or beyond either end, the other touching it near the middle."

Such a dynamo as that mentioned by Mrs. Mary Somerville and by Dr. Lodge gives, as might be expected, a low potential, but an apparatus of very small size will give sufficient tension for the deposition of copper, and it would not surprise us if a slight modification of this form should prove specially suitable for such purposes as welding, where a large current of low tension is needed. In such a case the resistance at the brushes would probably have to be reduced by such a device as setting the magnet vertically and making the circuit through mercury cups; the top or middle cup being, of course, annular, and having the bottom end of a vertical conducting cylinder dipping in it.

The sketch, Fig. 8, will serve to indicate a possible arrangement. It is sufficiently obvious that electromagnets can be used instead of permanent magnets in such a case as this, and that the self-exciting principle is applicable.

* Abstract from *Engineering*.
† Fig. 1 has a spindle armature, and Fig. 7 has a horseshoe armature, each having the one-direction commutator.

Notes on Permanent Magnets.*

BY SILVANUS P. THOMPSON, F. R. S.

Laminated Magnets.—Knight appears to have been the first to employ compound magnets made of bundles of steel plates separately magnetized. Since then many other experimenters have adopted this construction, notably Geuns, Coulomb and Scoresby. The advantage of this construction is that, in the methods adopted for hardening steel by sudden quenching, the hardening does not really penetrate far below the surface, and consequently the interior softer part of the bar adds nothing to the permanent magnetism, and may even weaken it so far as its external manifestation is concerned. Coulomb employed magnets made up of three laminæ, the central one projecting a little beyond the others, their ends being embedded in a soft iron pole piece. Scoresby,† who made many researches on compound magnets, showed that it was advantageous to separate the laminæ to a short distance apart. Some of his magnets, prepared from busk steel, are preserved in the museum at Whitby. He showed that such compound magnets may be made much more powerful than any single bar of weight equal to the combination can be made, but that the absolute gain of power in the combined mass, due to each additional lamina, di-

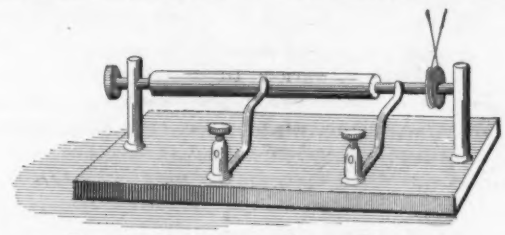


Fig. 7.—Sturgeon's Early Dynamo.

minishes progressively. For example, in a set of 30 plates the last 26 did not add to the first four more magnetic power than the first six had possessed alone. This is due to the tendency to mutual demagnetization; for in a powerful set the weaker plates not only add nothing, but have their polarity actually reversed by the more powerful ones. This state of things is partially remedied by preventing the actual contact of the plates by interposing sheets of paper or brass. Scoresby found that for compound horseshoe magnets the best temper was not glass-hard. He found it better to temper the hard steel plates by boiling them in linseed oil at 505 degrees F. (= 263 degrees C.). In this way he raised the lifting power of a 5-plate Stubbs steel horseshoe weighing 2.9 pounds

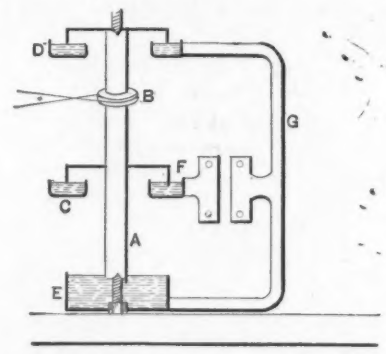


Fig. 8.—Sturgeon's Early Dynamo.

from 13–14 pounds to 25–26 pounds. And another 15-plate magnet weighing 8 pounds, which, when glass-hard would only carry 26 pounds, when thus tempered carried 45–50 pounds. Jamin,‡ who has gone over the same ground, has added little to the very complete investigations of Scoresby. Some makers of compound magnets arrange the tiers of plates in the form of steps at the extremities, the central plates being made longer than those on either side. There is no great gain in this arrangement, which is supposed to prevent the central plates from being reversed in polarity by those outside. It probably has the advantage of concentrating the magnetic lines, and so adding to the lifting power. Van der Willigen considered one millimetre a sufficient amount of projection for the central plate.

Traction or Lifting Power of Magnets.—Bernoulli's law that the tractive power of similar magnets was in proportion to the $\frac{2}{3}$th root of their weight, or, in other words, to the square of the cube root of their weight, was explained in my Cantor Lectures on the Electromagnet, and shown to mean merely that for equal magnetic saturation the tractive power was simply proportional to the polar area. If P stands for the greatest load which the magnet will carry, and W for its own weight, then Bernoulli's rule is

$$P = a \sqrt[3]{W^2};$$

where a is a constant depending on the units chosen, on the quality of steel, and on its degree of magnetization. If P and W are expressed in kilogrammes, then, according to the data of the best makers, a for horseshoe magnets will be between 18 and 24, or, say, on the average, 20. This means that if we consider a magnet weighing one kilogramme, it will carry a load of 20 kilogrammes, or 20 times its own weight. On this reckoning a magnet weighing 10 kilogrammes should carry 92.8 kilogrammes, or 9¼ times its own weight; while a magnet weighing 0.1 kilogramme

* From *The Electrician* (London).
† Scoresby's "Magnetical Investigations," Vol. I., pp. 98–329.
‡ *Comptes Rendus*, LXXVI., 1873, and in innumerable papers in the same journal since.

should carry 4.31 kilogrammes, or 43 times its own weight. If P and W are given in British pounds the value of the coefficient for the best sort of horseshoe magnets (corresponding with $a = 20$ for kilogramme units), will be 25.1, or, approximately, 25. That is to say, a really good steel horseshoe magnet weighing one pound should carry a load of 25 pounds. For example, one of Van Wetteren's magnets examined by Van der Willigen (magnet B) weighed 1.074 pounds, and carried, as the mean of seven observations, a load of 26.004 pounds.

The Haarlem Magnets.—The Haarlem magnets have been so justly celebrated for their admirable qualities that some notice of them seems to be called for. Logeman, who was continually advised by M. Elias, was the first to establish a name for the magnets made in Haarlem. By him, Van Wetteren, a most accomplished master-smith, had been employed. Later, when Funckler succeeded to Logeman's business, both Van Wetteren and Funckler continued to produce magnets on Elias' plan until, in 1874, M. Van der Willigen superseded that method of magnetization by a special method of magnetizing upon the poles of a Ruhmkorff's electromagnet, and applied it to the magnets forged by Van Wetteren. Of the special kind of steel employed, and of the mode of hardening and tempering adopted, nothing precise is stated in the otherwise valuable memoir of Van der Willigen* on the subject. In this memoir a detailed account is given of about 50 magnets, and of the loads which they carried after being magnetized in various ways and at various times. Most of these magnets were of the form shown in the figure. The contact surface of the keeper is slightly rounded. The figure is exactly one-quarter the natural size of the magnet A in the following list:

Mark on magnet.	Weight of magnet, in kilos.	Average load carried, in kilos.	Value of coefficient a.
A	0.495	13.30	21.25
B	0.487	11.78	19.03
E	0.889	19.02	20.57
3,057	1.013	21.71	21.52
3,053	1.521	27.90	21.17
3,054	1.918	32.53	21.07
C	2.169	35.47	21.10

The magnet A was 0.66 centimetre thick, its keeper 0.3 centimetre thick, the polar ends were 2.57 centimetres apart, and each of them was 2.68 centimetres wide. The extreme height from the outer side of the bend to the middle point between the poles was 17 centimetres. The area of the polar face was 1.769 square centimetres. The greatest width between the limbs below the bend was 3.65 centimetres. The magnets A, B, E and C were from one bar of steel. The magnet 3,053 was one shown in the Exhibition of Scientific Apparatus, at South Kensington, in 1876, while 3,054 was sent to the Centennial Exhibition, at Philadelphia, in the same year. When returned from the States in May, 1877, it was remagnetized, and carried 31.44 kilogrammes.

So far as the author is aware no British manufacturers have equaled the Haarlem makers; certainly none has surpassed them.

Scoresby† mentions a nine-plate compound horseshoe in his possession, weighing 22 pounds, which would carry from 66 to 88 pounds. By Bernoulli's formula, a 1-pound magnet, proportionately magnetized, would carry from 8.4 to 11.3 pounds—less than half the load which a 1-pound Haarlem magnet will carry. Scoresby also mentions a seven-plate steel horseshoe made by Dr. Schmidt, the property of the Royal Institution, which, though weighing 16 pounds, would only carry 28 pounds. Had this been a Haarlem magnet it would have carried at least 150 pounds.

Van der Willigen gave another formula for the tractive force of the Haarlem magnets, namely:

$$P = B \,.\, K\sqrt{\sigma}\,\sqrt[4]{\frac{L}{S}\cdot\frac{L}{l}};$$

where P is the tractive force in kilogrammes, S the area of one polar surface (in square centimetres), K the perimeter of one polar extremity, l the actual mean length of the horseshoe, L the "reduced length" (*i. e.*, the length between the points of maximum free magnetism observed on the flanks of the magnet, when keeper is in place), all the last being given in centimetres. B is a coefficient which varies between 0.7 and 1.2, and has a mean value of 0.891.

The tractive power of bar magnets is, of course, much less than that of horseshoes of equal weight, since the keeper is never so highly magnetized when applied to one pole. Van der Willigen states that for Van Wetteren's bar magnets the load carried by one pole is just a quarter of the load which a horseshoe (of weight equal to that of the bar) would carry. This means that Bernoulli's coefficient a (for kilogramme units) must be taken at about 5 for Haarlem bar magnets. The corresponding number for pound units will be 6¼. Has any British maker yet produced a steel bar magnet weighing 1 pound which will carry 6¼ pounds on one pole?

Maximum Values of Permanent Magnetism.—In the following table are given some of the values of maximum magnetization retained by actual steel magnets, magnetized by usual processes, and of the "specific magnetization" ς, or magnetic moment per gramme:

It is important to note, with respect to the following table, that there is a wide difference in the relative dimensions of the samples used by different observers. The ratio of length to diameter makes, as is known, a great difference to the temporary magnetization of a specimen; and in the case of permanent magnetization the differences are even more marked. In Schneebeli's experiments the length used was from 100 to 800 diameters. In Ewing's about 200. Hopkinson's results were with practically endless bars. Perry employed a horseshoe form, closed with an armature of soft iron. Gray* used square bars about 60 diameters long. Brown† used cylinders from 33 to 37 diameters; while Preece‡ used short, square bars, 10 centimetres in length and 1 centimetre in the side. The results given by Preece are the means of several samples of each sort, not the actual best obtained with each. For example, the mean residual **B** for Marchal's steel is given as 2,540, but the best magnet of this sort showed 2,835.

Observer and Material.	Residual **I**.	Residual **B**.	ς
Weber, common steel magnet	314	3,947	40
Von Waltenhofen, Tungsten steel, glass-hard	369	4,638	47
Schneebeli, sewing needles 2.5 to 6.6 centimetres long, 0.06 centimetre thick	557 to 671	7,001 to 8,435	71.4 to 86
Schneebeli, knitting needles, 19.8 to 21 centimetres long, 0.083 to 0.175 centimetre thick	765 to 832	9,626 to 10,458	98 to 107
Hopkinson, Tungsten steel, oil hardened	687	8,643	88
" " " very hard	542	6,818	70
Ewing, steel wire, glass-hard	541	6,800	69
" piano-forte wire, glass-hard	747	9,600	98
Perry, Jowitt's steel	1,003	12,600	129
Preece, Wall's steel	120	1,519	15.5
" Ashforth's steel	143.5	1,704	17.3
" Saunderson's steel	114.2	1,435	14 6
" Jowitt's steel	109.6	1,503	15.3
" Vickers' steel	93.4	1,174	12
" Crewe "rivet steel"	14.8	186.6	1.9
" Crewe "spring steel"	110 5	1,391	14.2
" Clemandot steel (compressed and tempered)	170	2,264	23.2
" Clemandot steel (compressed but untempered)	106.1	1,333	13.6
" Marchal steel	202 2	2,540	26
" Allevard steel (mercury hardened)	104.6	1,315	13.4
" " " (water hardened)	138.1	1,660	16.9
Gray, magnet steel, glass-hard	520	6,536	66
Evershed, Wall's and Jowitt's steels (mean)	318 to 398	4,000 to 5,000	41 to 51
Brown, magnet steel, glass-hard	477 to 556	6,000 to 7,000	61 to 72

The numbers given in the first column of figures of the last table are the values of the residual *magnetic moment per centimetre cube* of the substance (in C. G. S. measure),

VAN WETTEREN'S MAGNET (ONE-QUARTER ACTUAL SIZE).

and are obtained from the residual **B** by dividing by 4π. Many Continental writers on this subject prefer to give the values in terms of the *magnetic moment per gramme*, a quantity which is also called the *specific magnetization* of the material. If the density of the specimen is known, the specific magnetization σ can be calculated from the residual **I** by dividing by the density. For example, taking Gray's figure of 9,804 for the residual **B**, dividing by 4π gives residual **I**, and dividing by 7.8 (which we assume as the density of the steel) gives 100 for the specific magnetization. In all the preceding table the only samples showing values over 100 for the specific magnetization are those obtained by Schneebeli and by Perry. Preece's results for *short* magnets of 10 diameters show specific magnetizations varying from 2 (Crewe "rivet steel") to 26 (Marchal steel).

Ewing found, using enormous magnetizing forces which pushed the temporary value of **B** for Lowmoor and Swedish iron to over 30,000, that the residual values of **B** were only 510 and 500 respectively, while cast iron showed only 400. This means residual **I** of 40, 39 and 32 respectively, and specific magnetization of between 6 and 5 only. Du Bois, also using abnormally strong fields, found the residual specific magnetization for electrolytically deposited nickel 10.6, and for electrolytic iron from 70 to 106.

Influence of Temper and Grain.—In the preparation of permanent magnets, temper is almost as important a consideration as the chemical composition of the material. Most makers have their own favorite method of hardening and tempering, and few can or will give exact particulars. Neither is it possible to give a universal rule as to the best process to follow; for the process of tempering which is best for one brand of steel is different from that which is best for another brand. Tempering does not mean the process of hardening, though careless writers sometimes confuse their meaning by using the term in this erroneous sense. Tempering means the process of letting the steel down to a softer state by a partial reheating subsequently to the hardening. Moreover, as will be seen, the temper which is best for *short* magnets is quite different from that which is best for *long* magnets and horseshoe forms. There is, however, no doubt that it is eminently desirable to secure a fine, even, uniform grain, since any lack of homogeneity tends to reduce the quality of the magnet. An unskillful smith in forging a magnet will spoil its structure by working it too much and unequally. It is commonly supposed that the harder a piece of steel is, the greater retentive power will it exhibit. But under this term two separate qualities must be distinguished. Some steels will show, after magnetization, a large residual magnetization, which, however, decays as weeks and months pass away. Some other qualities of steel will exhibit a lesser remanence, but will conserve much longer what they have thus retained. The question of constancy of retention will be separately considered hereafter.

(*To be continued.*)

* Sur le Magnétisme des Aimants Artificiels. "Arch. du Musée Teyler" (Haarlem), Vol. IV., 1878.
† Part I., *The Electrician*, July 3, p. 240.

* *Phil. Mag.*, December, 1885. † *Phil. Mag.*, May, 1887.
‡ *The Electrician*, vol. XXV., p. 547, September 19, 1890.

The Cost of Electric Traction.

The June statement of the operations of the West End Railway Company, of Boston, shows, as did the statements for April and May, published in the last issue of THE ELECTRICAL WORLD, the comparative earnings and expenses of the electric and horse car departments. The figures are actual wherever possible, and are divided pro rata according to mileage wherever actual figures cannot be had. Injuries and damages, for example, are charged to the electric or horse cars, according as one or the other caused the damage. These are actual payments in the month. Conductors' and drivers' wages are actual; so is renewal of horses. General and track expenses are apportioned according to mileage. Here is the June statement as prepared by the company's auditor:

Earnings.	Total.	Electric.	Horse.
Passengers	$544,297	$152,668	$391,628
Rent, less repairs	1,751	440	1,310
Other income except manure	3,495	879	2,616
Total earnings	$549,543	$153,988	$395,555
Operating expenses:			
General	$29,683	$7,465	$22,217
Maintenance of track	13,258	3,334	9,923
Maintenance of buildings	2.519	462	2,057
Maintenance of cars, etc	10,860	4,281	6,579
Superintendence	11,621	2,397	9,223
Road and snow	5,820	1,463	4,355
Injuries and damages	2,197	560	1,637
Car and lamp cleaners	4,046	1,000	3,045
Conductors and drivers	114,706	26,132	88,573
Total motive power	$142,570	$26,359	$116,210
Total operating expenses	$337,284	$73,459	$263,825
Net earnings	$212,259	$80,529	$131,729

REVENUE MILEAGE.

	Total.	Electric.	Horse.
Revenue mileage	1,433,785	360,568	1,073,213
Ratio of mileage	100	25.15	74.85
Ratio of net earnings	100	37.94	62.06
Operating expenses per cent. of earnings	61.37	47.70	66.70

EARNINGS AND EXPENSES PER MILE RUN FOR REVENUE.

	Total. Cents.	Electric. Cents.	Horse. Cents.
Earnings per mile	38.33	42.71	36.85
Expenses for motive power	9.94	7.31	10.83
Expenses for car repairs	0.76	1.18	0.61
Expenses for damages	0.15	0.16	0.15
Expenses for conductors and drivers	8.00	7.25	8.25
Other expenses	4.67	4.47	4.24
Total expenses per mile	23.52	20.37	24.58
Net earnings per mile	14.31	22.34	12.27

The earnings, expenses and net earnings for the three months may be thus contrasted:

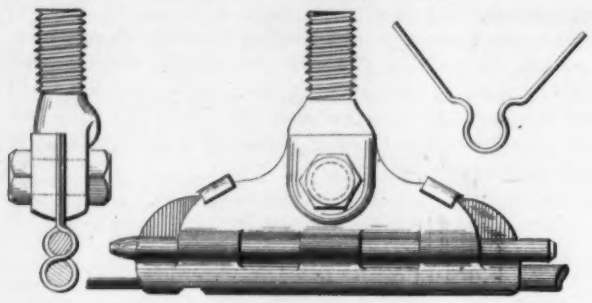
	Total.	Electric.	Horse.
April.			
Earnings	$478,717	$134,321	$344,396
Expenses	362,781	85,834	276,947
Net	$115,936	$48,487	$67,449
May.			
Earnings	$519,244	$144,638	$374,605
Expenses	353,720	84,163	269,556
Net	$165,524	$60,475	$105,049
June.			
Earnings	$549,543	$153,988	$395,555
Expenses	337,284	73,459	263,825
Net	$212,259	$80,529	$131,730
Three months to June 30.			
Earnings	$1,547,504	$432,947	$1,114,556
Expenses	1,053,788	243,456	810,328
Net	$493,719	$189,491	$304,228

The percentage of operating expense to gross earnings was for the quarter 56.23 for electricity and 72.7 for horse power. One thing which reduced the expense of the electric cars in June was the quite general use of open cars requiring but one motor, and then the contract with the Edison company for power was terminated with May. That saved perhaps one cent per mile. On Sept. 1 other hired power will be discontinued, and the railway company will start its great engines in its own power house. This is expected to save two or three cents more per mile. By winter the company has planned to have 400 long cars in use and to be operating the Jamaica Plain and Tremont Street lines, the Charlestown line to Sullivan Square and the South Boston lines by electricity, and, as has been before remarked,

the long cars are found more profitable than the short ones. The road has ordered 150 new cars, and President Whitney is considering the question of getting some double-deck cars. He is desirous of converting the whole mileage into electric mileage as soon as possible, and when this is accomplished most gratifying net earnings per mile are looked for.

A New Trolley-Wire Hanger.

Mr. T. J. McTighe, of J. F. Barry & Co., 5 William street, New York, is about to place on the market a new trolley-wire hanger. Its novel features lie in the peculiar form of



Trolley Wire Hanger.

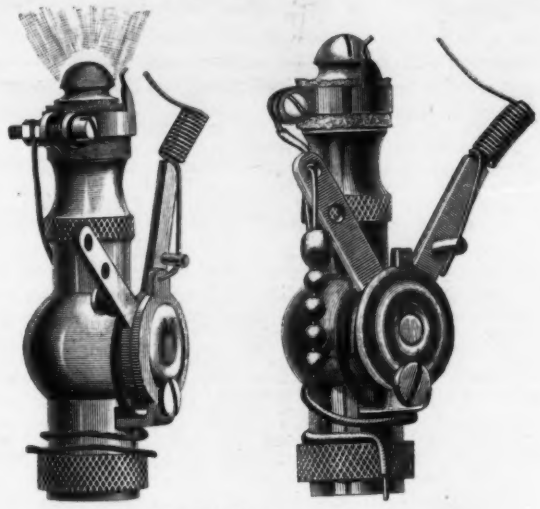
clip, which is composed of a single piece of hard rolled sheet copper stamped out in such form that it may be folded up from beneath around the trolley wire, and the folded ends clamped together and supported by any of the usual forms of insulators. The final tightening on the wire is done by means of the key bolt shown in the cut, which, acting on the interlaced portions of the clip, causes the latter to tighten around the wire after the manner of a strap. By suitable selection of the size of key, any degree of grip may be obtained, and any of the usual sizes of trolley wire may be used without changing the construction of the clip. The most important advantage, however, which will be appreciated by expert linemen, lies in the fact that the clips may be attached to the trolley wire and to the line hangers without actually tightening the clips themselves on the trolley wire, and this operation may be deferred until such time as the entire line is ready for drawing in and straightening, and then is it only necessary to apply key bolts.

Again, after a line has become stretched and needs tightening, this hanger permits the key bolts to be withdrawn from any desired section of the line so that the latter may be adjusted. During this operation there is no possibility of the trolley wire falling to the street, and the motor traffic is not obstructed.

For curve hangers the suspension bolt is made with a broad downward extension which neatly fits the face of the clip and gives it all necessary lateral support.

An Improved Electric Gas Lighter.

The accompanying cuts show the appearance and working of the improved double contact and "pass-by" pendant burner, manufactured by the Electric Gas Lighting Company, 195 Devonshire street, Boston. This burner obviates the difficulties encountered by the old-style burners caused by grounding the battery or of catching and holding the electrode in the flame until the conductivity is destroyed. The burner has an attachment upon its movable arm



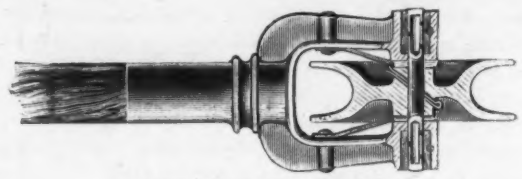
Figs. 1 and 2.—Electric Gas Lighter.

whereby not only a positive connection is made with the body of the burner by which the current is taken to the ground, but which also throws the German silver wipe-spring out of the flame on its return to position after the burner is lighted as is shown in the figure.

The Lieb Trolley.

The Lieb perfected trolley, which was illustrated and described in The Electrical World of November 22, 1890, is now placed upon the market with some very radical changes in its construction. The aluminium wheel which was at first used was found to be not suitable for the purpose, and it has been replaced by a similar one of other material. The trolley base is essentially the same as in the former construction, except that the pull on the side springs is now applied in such a way as to leave only a very slight resistance to the movement of the trolley pole and wheel in a lateral direction.

The accompanying cut shows the Lieb trolley wheel and fork in section. It is said that this is the only trolley wheel made in which the spindle revolves with the wheel, and the advantages of this construction are obvious. The wear due to the friction will be such that the trolley spindle and the bearing in which it revolves will always have a perfect fit, and the wheel will turn easily upon its centre. It is often the case when the trolley wheel turns upon the spindle that the bearing inside the wheel soon wears into a shape other than circular, causing a very uneven and undesirable motion of the wheel. The spindle is bored out at each end, the cavities thus formed being filled with oiled felt; three small holes extending from the cavities to the surface of the spindle serve to carry the necessary amount of lubrication to the wearing surfaces. Lignum vitæ bushings are used, and these can be replaced without removing the trolley wheel. The tension brought upon the trolley pole by the springs of the base is so evenly distributed for the different

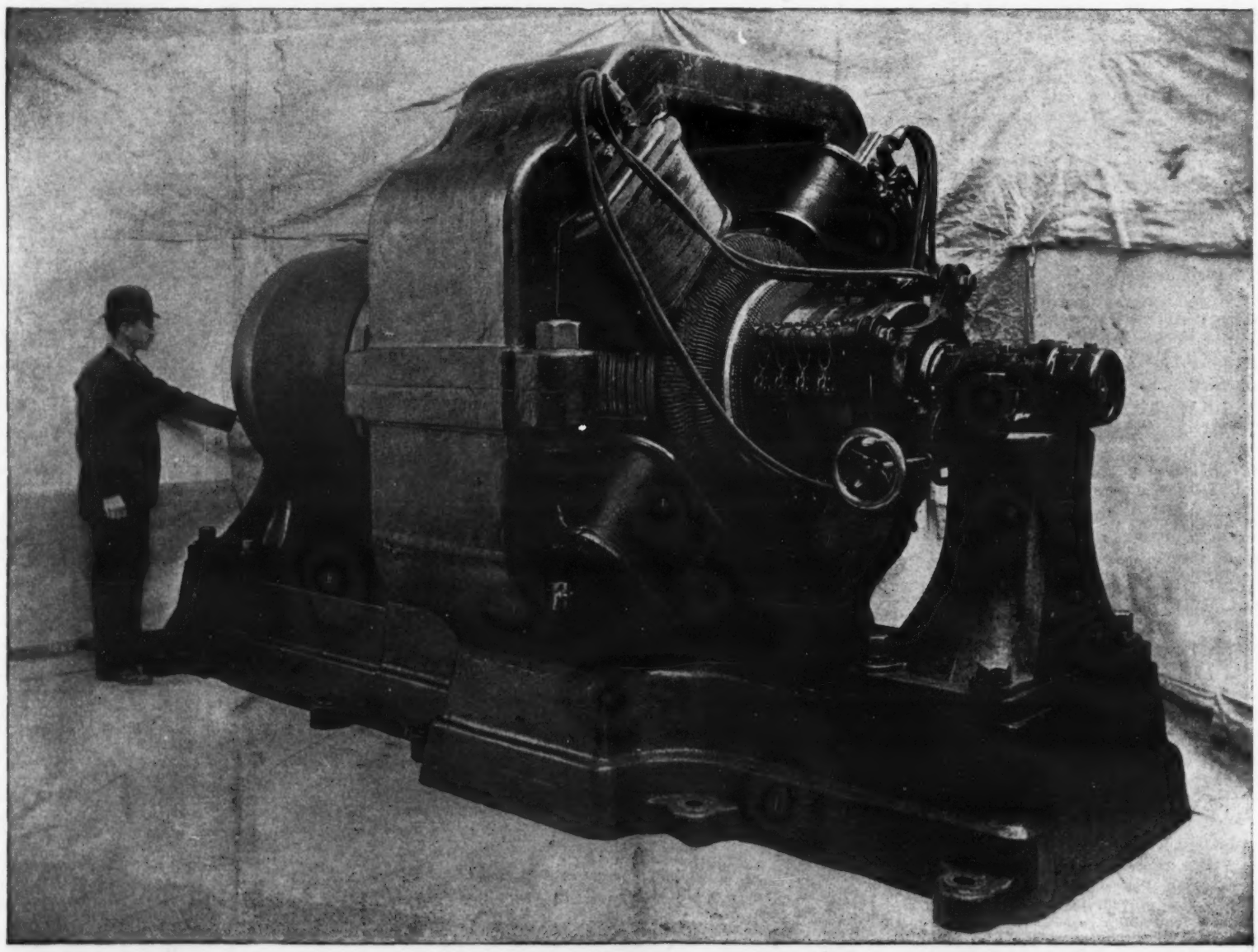


Lieb Trolley Wheel.

positions of the pole that it is possible to pass under a bridge only five inches higher than the top of the car. It will be noticed also that to make this possible the trolley base itself must project less than five inches above the car.

The Thomson-Houston 250,000 Watt Generator.

The erection of power stations of large capacity for operating electric street railways in our large cities has created a demand for generators of greater output than have been heretofore employed. The first type of railway generator brought out by the Thomson-Houston Electric Company was a two pole machine of the motor type pattern, having an output of 62,000 watts, which was followed by a four pole machine of 75,000 watts capacity, which in turn has been followed by a generator of the same type, having an output of 250,000 watts. The general construction of this machine can be readily seen from the accompanying illustration. The armature is of the ring pattern and so constructed that opportunity is afforded for better insulation than can be obtained with other types of armatures, and the danger due to great difference of potential between any two of its conductors is avoided.



THE THOMSON-HOUSTON 250,000-WATT GENERATOR.

One of the most important features of this generator is the arrangement for lubrication and good alignment of the bearings. The boxes are made in two parts and are entirely separate from the stands. On the top of the stand is a seat into which the spherical surface of the box fits and in which the box is free to move. The bolts which secure it to the stand are smaller than the holes which are drilled through

the box, so that a slight play of box in the seat is permitted. The bearing shells or linings are removable, and are made in the following manner:

A skeleton shell of brass is made, the interstices of which are filled with Magnolia metal. This is then bored and reamed to size, oilways being cut so that the oil circulation begins at the point where the oil rings touch the shaft. This method of manufacture permits a perfect circulation of oil, insures the cool running of the bearings, and greatly reduces the care and attention required by the dynamo when in operation. This type of box and bearing lining has proved so satisfactory that it is now being introduced in machines of smaller size, and will in future be used on all machines of large capacity. In order that the outboard bearings may be perfectly aligned with the other bearings, the stand of the extension base has two adjustments—one in a horizontal and the other in a vertical direction. These adjustments are made by the screws. Whenever it is necessary to examine bearing linings the armature is jacked up about one-sixteenth of an inch, so that the bearing is relieved of its weight, two bolts removed from each stand and the entire box taken out. In case it is not desired to remove the box the cap can be taken off and the bearing linings readily removed. The movement of the brushes is effected by means of the shaft, on which a small worm is attached, and which in turn works in a rack fastened to the yoke. By means of this a very fine adjustment of the brushes can be made. The worm locks the yoke so that it cannot be moved except by hand. In order that the conductors inside the armature may be held securely in place, an adjustable, internal wire support has been designed. When the armature is being wound the wires are forced into position so that they cannot sag, vibrate or chafe the insulation.

The commutator, which has 180 sections, is designed and constructed with great care and in practice has been satisfactory in every way. The fields will be separately excited, although the connection at the switchboard is so arranged that by throwing a switch the dynamo can be made self-exciting should emergency require it.

The total floor space occupied by this generator is 13 feet 3½ inches × 7 feet 1 inch. The height of the machine is a little less than eight feet. The pulley is 43 inches in diameter and has a 35-inch face. The speed is 400 revolutions per minute. The weight complete is about 21 tons.

Opinion of Judge Coxe, in the Case of the Brush Electric Company vs. The Electrical Accumulator Company et al.*

This is an equity action founded upon three letters patent granted to Charles F. Brush for improvements in secondary batteries, as follows: No. 337,299, granted March 2, 1886; No. 260,654, granted July 4, 1882, and No. 266,090, granted October 17, 1882.

These patents and one other, No. 337,298, granted March 2, 1886, were before this Court in *Brush Co.* vs. *Julien Co.*, 41 Fed. Rep., 679. The Court there decided that No. 337,298 and No. 337,299 were for the same invention and intimated, as the inventor and his expert apparently regarded the former as the broader patent, that the difficulty might be met by a surrender of the latter or by a disclaimer of similar claims therein. This solution of the difficulty was thrown out as a suggestion merely, the final disposition of the patents being left till the settlement of the decree.

It was not the intention of the Court to decide that one of these patents was entitled to preference over the other. For the reason stated, and for convenience of illustration No. 337,298 was given prominence in the discussion, but the conclusion would have been the same had the position of the patents been reversed.

Upon the settlement of the decree the complainant selected No. 337,299 as the patent upon which it chose to rely, and withdrew No. 337,298 from the consideration of the Court. This was done without objection by the defendant in that case.

On the 15th of July, 1890, after the decree in the *Brush-Julien* case was entered, the complainant withdrew No. 337,298 from this cause, and an order was entered dismissing the bill as to that patent. The cause has since proceeded upon the three patents as stated.

In the prior litigations involving the subject matter of these patents the following propositions have been decided:

First.—That Mr. Brush was the first in this country to hold absorptive substance in the form of dry powder in place on the supports of a secondary battery by paper or equivalent material, and the first who rammed or pressed it into grooves or receptacles in the plates.

Second.—That No. 337,298 and No. 337,299 are for the same invention, and that the complainant was not entitled to both patents, but was entitled to one.

Third.—The complainant having elected to hold No. 337,299, it was decided by the decree that claims numbers one, two, three, six, seven, eleven, twelve and thirteen were valid, the word "perforations" in claims numbers six and seven being construed as synonymous with "cells or cavities."

Fourth.—That the claim of No. 260,654 was not infringed by the application of the absorptive substance to the grids by a trowel or spatula.

Fifth.—That the defendants, by the use of supports filled with rows of uniform square holes, did not infringe the "rib claims" of No. 266,090.

Sixth.—That claims numbers seven and fourteen of No. 266,090, the latter claim being limited to the "perforations" described, were valid and infringed.

Seventh.—That No. 337,298 (and by implication No. 337,299) was not invalidated by patents Nos. 261,512 and 261,995, granted to Mr. Brush, July 18, and August 1, 1882, respectively.

Eighth.—That No. 337,298 (and by implication No. 337,299) was not invalidated by the expiration of the Brush Italian patent.

*Filed in the U. S. Circuit Court, New York City, July 23, 1891.

Brush vs. *Julien*, 41 Fed. Rep., 679; *Accumulator* vs. *Julien*, 38 Fed. Rep., 126.

All of these conclusions were reached after careful study and mature deliberation, and now, after having been re-examined in the light of the present record, arguments and briefs, except as to claims numbers eleven and thirteen of No. 337,229, are reaffirmed. No useful purpose would be subserved by again discussing them, as such a task would only involve a repetition of what has been said already in the other cases.

The proof of infringement is substantially the same as in the *Brush-Julien* case. It is more complete as to the manner in which the active material is applied to the plates, but in this respect it only emphasizes the former decision as to the non-infringement of the claim of No. 260,654. That claim is as follows:

"The method of forming the plates of a secondary battery, consisting in forming receptacles for oxide of lead in its surface, then applying oxide of lead to the plate and within such receptacles and afterward subjecting the oxide of lead to pressure."

The claim clearly contemplates not only the treatment adopted by the defendants, but *afterward* subjecting the oxide to pressure. The defendants apply the oxide to the plates and within the receptacles with a wooden trowel in the hands of the workman, and there they stop. They do not subject the oxide to pressure afterward.

The questions arising upon the expiration of the Italian patent and as to the validity of the "red lead claims" are, however, presented by this record in a new and different aspect, and may with entire propriety be examined *de novo*, together with the question, not heretofore considered, relating to the effect of the Brush patents Nos. 260,653 and 276,155 upon the broad patent in suit.

First.—It is thought that claims numbers eleven and thirteen of No. 337,299—the red lead claims—are void for lack of invention. The specification, after referring to lead oxide as the active material, which is primarily and mechanically applied to the plates, proceeds:

"Peroxide is the best oxide of lead to use in the preparation of the plates; but as this is rather expensive to prepare red lead or minium may be used."

If the record contained nothing but this statement the claims could not be upheld. After the invention of a support primarily coated with mechanically applied oxide of lead, merely coating the plate with the commonest, cheapest and best known form of lead oxide did not require the exercise of the inventive facilities. Especially is this so when the patentee himself asserts that the best results can be obtained by using peroxide. It would seem that the use of red lead would at once occur to any one who had even a superficial knowledge of the art. There is no more novelty in using red lead for the coatings than there is in using cast lead for the plates. (*Brush v. Julien*, *supra*, p. 692.)

The following paragraph taken from defendants' brief states with clearness and precision the views of the Court upon this subject:

"The specification says that red lead is inferior to the peroxide, and we submit that no valid claim can be founded upon the use of an inferior article when it is shown that the use of the superior article is old."

Patent No. 337,299, at least as far as its broad claims are concerned, is not invalidated by anything contained in the Brush patents No. 260,653 and No. 276,155. The application for the former (No. 260,653) was filed June 15, 1882, a year and two days after the application of No. 337,299.

No one can read the specification of No. 260,653 without being impressed with the fact that the inventor intended to confine the patent to a single point, namely, the form of the electrodes. He expressly says so:

"This application is a division of my application designated as 'Case I' [337,298–9], filed June 13, 1881, in which other features of my invention are claimed. For convenience in distinguishing this invention among others of mine in the class of secondary batteries, I have denominated it 'Case I., Division A.'"

Again he says:

"My invention consists essentially in a secondary battery element consisting of a structure of etagère-like form, containing in the spaces between its shelves lead in a finely divided state."

The claim is:

"In a secondary battery, an element consisting of a structure of etagère-like form, containing in the spaces between its shelves lead in a finely divided state, substantially as set forth."

It is true that the broad invention is described, but it is equally true that is is not claimed. It was hardly possible for the patentee to describe the subsidiary invention without disclosing his main invention. Having disclosed it, had he permitted the patent to issue without warning or reservation, and, after the broad invention became public property, had filed an application covering what he had thus relinquished to others, it is probable that he would have been informed, either in the Patent Office or in the courts, that his application came too late. But that is not this case. Before his application for the subordinate invention he had applied for the superior one. In the former he expressly informed the public that it was but a division of the latter. He could do no more. The delay in the Patent Office cannot be charged to him. Even though the inventor were responsible for the issue of the divisional before the principal patent—and he was not—the fact of such prior issue in no way misled the public. They never for a moment acquired the right to use the broad invention. An infringer, with the statements on the face of No. 260,653 before him, would scarcely have the hardihood to assert that he supposed the broad invention was released. No court would listen to such a plea. The claims of that patent did not protect Mr. Brush in the use of the broad invention. A person who did not use an "etagère-shaped" plate could, if no other patent prevented, use the broad invention with perfect impunity. No. 337,299 was intended to prevent such use.

The Court has not been able to discover an authority holding a broad patent invalid in such circumstances. None has been cited by counsel.

What is true of No. 260,653 is also true of No. 276,155.

Mr. Brush was the first in this country to make the broad invention as stated above. He is entitled to the fruits of his invention. It is the policy of the law to reward him.

Where the Court can see that the patentee has produced an invention of real merit, it should not be unduly industrious in endeavoring to discover some statement or act of his by which, on technical grounds, his rights may be forfeited. It should rather be sedulous to protect him.

Whether or not the improvements patented by Nos. 260,653 and 276,155 are the same as the improvements covered by some of the claims of Nos. 337,299 and 266,090 it is, perhaps, unnecessary to decide, for none of the claims in issue and infringed are so affected.

It seems that in his anxiety to claim his invention in every conceivable form, the patentee has involved himself in a labyrinth of descriptions and claims in which electrician and lawyer alike are quite apt to become confused.

What Mr. Brush accomplished in 1879 and 1880 can be embraced in a brief, clear and concise statement. What he actually did is the test by which his patents must be judged. He is entitled to what he invented and only this. His patents can receive no broader construction, because he described his inventions with irksome prolixity and gives to the same structure a wearisome variety of names. The nomenclaturist should not seek the reward for his labors in the Patent Office. A person is not entitled to a patent because he has invented a new word. The danger and impropriety of holding a number of claims relating to the same structure, and which can be differentiated only by the most abstruse and metaphysical distinctions, seem apparent. They are calculated to embarrass the inventor and mislead the public.

Did patents Nos. 337,299 and 266,090 expire with the Italian patent?

The Italian patent was applied for July 28, 1882, sealed Aug. 8, 1882, and was issued for a term of three years from Sept. 30, 1882. It expired Sept. 30, 1885, never having been prolonged, renewed or extended. No. 337,299 was granted March 2, 1886; No. 266,090, Oct. 17, 1882; both were applied for in June, 1881.

Having stipulated that the patent was issued for an unextended term, from September 30, 1882, and that the translation appearing in the record is a correct one, the complainant is not in a position to argue that the patent was either extended as to time or limited as to its terms. Especially is this so in the absence of the Italian patent law, which is not in evidence, and of all proof tending to establish either extension or limitation.

The difficulty with the complainant's argument in this regard is twofold; first, there is no law, and, second, there are no facts upon which to base it.

Section 4,887 of the Revised Statutes is as follows:

"No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention, which has been previously patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years."

Under this section the test of identity between the foreign and domestic patent, as established by the Supreme Court in two recent decisions, may be stated as follows:

Is the principal invention in each, is the thing patented abroad, the same in all essential particulars as the thing patented here? Would the home patent be infringed by a structure made in accordance with the provisions of the foreign patent?

In cases where these questions are answered in the affirmative the United States patent falls, and it will not be saved by the fact that it contains improvements not found in the foreign patent.

Siemens vs. *Sellers*, 123 U. S., 276; *Com. Co.* vs. *Fairbanks Co.*, 135 U. S., 176.

Whether the expiration of a foreign patent for an improvement only will operate to overthrow a domestic patent for a broad invention, which contains also a claim covering the improvement, has not apparently been decided by the Supreme Court. The language of the court, in *Siemens* vs. *Sellers*, *supra*, is, perhaps, comprehensive enough to cover such a contingency, but this is a question which need not now be considered.

In the *Brush-Julien* case the Court commented upon the absence of expert testimony relating to the Italian patent. No similar observation can, with propriety, be made regarding the present record. It would indicate a lamentable want of appreciation on the part of the Court to ask for additional instruction and advice. Eight experts of greater or less prominence and attainments have testified upon this subject. Three of these called by the defendants have expressed the opinion that the divisions of the Italian patent describe everything claimed in the United States patents granted to Mr. Brush and that the inventions covered by the two patents, No. 337,299 and No. 266,090, are literally described and substantially claimed in the Italian patent.

On the other hand five electricians, including the patentee himself, have testified that the Italian patent relates to inventions wholly different and proceeds upon totally dissimilar lines. In short, that it is but a progressive step in the Planté method, its object being to aid the process of electrical disintegration of the plates in the electrolyte, and not to supersede that process by placing the active material mechanically upon the plates prior to immersion in the battery fluid.

The mere fact that these gentlemen of conceded ability and learning, whose motive is to enlighten the Court and who were all sworn to tell the truth, differ so radically regarding the meaning of the Italian patent is of itself suggestive:

The defendants plead the defense of forfeiture. They must prove it by a preponderance of evidence. And yet upon the question of the identity of the patents in question there is a sharp difference of opinion among those who are most entitled to speak upon the subject. Is there not room for the assertion that the defendants have failed to sustain the burden in this behalf?

When this question was presented in the *Brush-Julien* case the mind of the Court was in doubt, and now, having reread the Italian patent in the light of the new testimony, it is still in doubt, but inclining more strongly to the opinion that the complainant's contention is correct. The Court is not prepared to hold, therefore, that the Italian patent is for the same inventions as those covered by the two patents in question.

The principal reasons which led the Court to adopt this view may be epitomized as follows:

First.—The language of the Italian patent is entirely different from that of the patents in suit. The drawings are different.

Some of the divisions of the Italian patent are unquestionably dissimilar, and some concededly relate to the Planté process. The broad statement relating to the primary coating of the supports with active material is not found in the Italian patent.

Second.—The inventor's statement of his intent and purpose in taking the foreign patent, and his reasons for not attempting to patent the invention of No. 337,299 abroad.

This testimony is corroborated by his notes made at the time he was perfecting the inventions patented abroad. When these notes are placed side by side with corresponding portions of the Italian patent it will be seen that they are substantially similar. Mr. Brush testifies that the portion quoted describes the invention of Division D of the Italian patent.

Brush's Notes, March 7, 1882.

"About three weeks ago I conceived the idea of preparing secondary battery plates by compressing partially oxidized precipitated metallic lead, in the form of a fine powder, with great pressure, whereby I expect to get a solid metallic plate coherent and malleable. * * * Now by using very finely granulated or precipitated lead, and slightly oxidizing superficially each particle, spontaneously by exposure to the air, or otherwise, and then compressing the metal, I will get a lead plate having minute seams throughout its substance filled with oxide of lead. This will very greatly facilitate the oxidation of the plate in the process of 'forming' in the battery. It will probably be found advantageous to coat a sheet of ordinary rolled lead on one or both sides with this peculiar fissured metal, so that the rapid oxidation in the battery will be arrested by the rolled metal when the prepared metal is all oxidized."

Division D, Italian Patent.

"In this division I shall treat a secondary battery element, wherein, before treatment by a 'forming' process, either the entire body thereof, or only the coating or covering of a suitable core or body, consists of a mass, composed of metallic lead and lead-oxide, in an intimately mixed condition, pressed or united together into a compact and firmly coherent mass.

"In constructing this mass I take metallic lead in the pulverized, granulated, precipitated, or other finely divided state, and allow the surface of the lead particles to become oxidized, either by exposure to the air, or by any suitable artificial oxidizing process or application. * * * I now subject the mixture to heavy pressure, hydraulic or otherwise, whereby its particles are united and consolidated into a compact and firmly coherent mass. The mass thus formed consists of metallic lead, having minute veins of oxide of lead everywhere ramifying and extending through it; and these veins of lead-oxide within and throughout the mass greatly facilitate the penetration of the electrical action in 'forming' the plates for operative use in secondary batteries."

The notes of March, 1882, seem to describe the invention of Division D; they certainly do not describe the invention of No. 337,299.

Third.—United States patents, other than those in question, were issued to Mr. Brush for the divisions of the Italian patent, evidently including Division D. At that time, therefore, neither the inventor nor the Patent Office officials thought these inventions, or any of them, were the same as No. 337,299. Furthermore, the attention of the officials was particularly called to the foreign patents.

The opinion of the United States officials seems to have been entertained also by those of Italy, France and England.

Faure's invention was well known abroad, and yet the patents issued to Brush with no objection, apparently, from any source that they interfered with Faure.

Fourth.—The fact that a sharp distinction is drawn in No. 337,299 between the inventor's and Planté's method. Mr. Brush claims his secondary battery element "as contradistinguished from a plate or element having the active material produced by the disintregrating action of electricity as in the well-known Planté process."

There is nothing of this in the Italian patent. On the other hand the inventor clearly intimates that the plates of Division D are to be formed by the Planté process.

Fifth.—The vast superiority of the electrodes of the United States patents in question over those made in accordance with the directions of the Italian patent as demonstrated by the experiments of the complainant's experts.

A careful reading of Division D in the light of the testimony has convinced the Court that some, at least, of these experimental plates are made in conformity with the formula of that division. None of them are like the plates of No. 337,299.

Sixth.—The Italian patent is capable of a narrow construction which differentiates it from the patents in suit.

When to the statements of the patent itself is added the testimony of the inventor that he intended to limit the patent in all its branches to a coating formed by the action of the electric current and that he did not intend it to cover a coating placed on the plates mechanically before they are subjected to electrical action, there seems to be every reason why the narrower construction should be adopted.

Seventh.—The fact that the element of the Italian patent is produced by heavy pressure, hydraulic or otherwise, whereby the particles of lead and lead oxide are compacted into a firmly coherent mass having minute veins of oxide of lead everywhere ramifying through it.

There is nothing resembling this in the United States patents in suit.

Eighth.—The "mass" described in the Italian patent is malleable and capable of being made into strips or wires and manipulated so as to form any style of element.

Neither the active material of No. 337,299 nor the completed plate of that patent is capable of such treatment.

Ninth.—No. 337,299 is designed to cover Mr. Brush's inventions made in the summer of 1879 and in the summer and autumn of 1880.

Brush vs. *Julien*, *supra*, 687; *Accumulator* vs. *Julien*, *supra*, 129-131.

Bearing this in mind it is quite clear that the discoveries of these years alone are insufficient to support the Italian patent. Something more is required. What Mr. Brush did in 1879 and 1880 is not described in the Italian patent. What he did in 1882 is described there.

The foregoing are some of the reasons which have induced the Court to overrule the defense of forfeiture; in fact, the more the Italian patent is studied the more settled becomes the conviction that it is not for the same invention as No. 337,299.

Apply the test suggested in *Commercial Manufacturing Company* vs. *Fairbanks Company*, 135 U. S., 176, 194. If a person in this country, after the issue of No. 337,299, were to commence the manufacture of secondary batteries by the precise processes described in the Italian patent, would the courts refuse an injunction to restrain their use on the ground that they do not infringe the claims of the United States patents?

It is thought, upon the conflicting testimony here presented, an intelligent court would feel compelled to deny an injunction on the ground that infringement was not proved, or, at least, that the question was involved in such uncertainty and doubt as to justify the court in withholding the writ.

It may as well be admitted that this defense does not appeal strongly to the conscience of a court of equity. The statute creates it, and in all cases where the facts are clear the statute must be implicitly followed. But no one can examine the course of judicial decision upon the subject without being impressed with the fact that the courts have sought to construe it liberally, and have seldom, except in the plainest cases, permitted it to defeat a valuable patent.

Believing that Mr. Brush is entitled under our law to protection for a meritorious invention the Court should not, unless fully convinced that the facts warrant such a course, destroy his patents upon grounds which do not go to the merits of the invention, and which, for want of a more accurate word, may be termed *technical*.

Why a meritorious inventor, who is a citizen of this republic, should lose his rights at home because he has tried to protect them abroad, is, on principle, not easy to comprehend.

It is said that the expiration of the Italian patent threw the invention into public domain. So it did into the domain of the Italian public, but if Mr. Brush had taken no patent in Italy the Italian public could have practiced the invention from the moment it became known there. Had he taken no foreign patents his invention would have been thrown into the public domain of every land but this. In this country his inventions would have been protected for seventeen years; outside of this country they could have been used with perfect impunity. The inventor applied for his patent here long before he applied abroad, but through the delay of the Patent Office the foreign patents were issued first.

Assuming the inventions to be similar, the inventor has been guilty of no fault, the American public has lost no rights, and yet, under the provisions of this statute, which, it is thought, was never intended to apply to a case like this, a valuable monopoly is destroyed.

These observations are, perhaps, only germane to the present inquiry as they tend to emphasize the suggestion already made that in dealing with a defense where, as in this case, the disaster following the inventor's acts is so out of proportion with the fault, if fault it be, the Court should proceed with the utmost caution, and, where the evidence is not clear, give to the inventor the benefit of the doubt. If convinced that he did not intend to patent the invention abroad, the Court should not by construction broaden the language of the foreign patent so as to destroy the domestic patent, when that language is capable of a construction which permits the domestic patent to live.

The question of how to dispose of No. 337,298 is, in view of complainant's position regarding it, more puzzling than ever. The rule which obtains in this circuit, requiring a disclaimer of invalid claims as a condition of a decree, has always seemed an arbitrary one. It certainly seems inequitable that the court, at *nisi prius*, should compel the patentee to renounce forever a claim which may be held valid upon appeal. It is possible that this rule may be modified by the Circuit Court of Appeals.

In view of this contingency and of the extraordinary and distinguishing circumstances surrounding this case the Court has concluded, if the complainant upon reflection still desires to assume the responsibility of retaining two patents for the same invention, not to require a surrender or disclaimer of No. 337,298 as a condition of a decree. It is thought, however, that pending an appeal it should be deposited with the clerk to await the further order of the Court.

An accounting having been waived, it follows that on filing a disclaimer of claims 11 and 13 of patent No. 337,299 the complainant is entitled to a decree upon claims 1, 2, 3, 6, 7 and 12 of this patent, and upon claims 7 and 14 of No. 266,090, for an injunction, but without costs.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

Thomson-Houston Bonds.—Three thousand dollars of the Thomson-Houston Electric Company's five per cent. gold collateral bonds, due 1919, were sold at auction in New York last week at 80½.

Western Union.—The story is told that at the end of the fiscal year, on Sept. 30, the Western Union company will follow in the footsteps of the Vanderbilt roads and declare an extra dividend of one per cent. out of the net earnings for the fiscal year which ends at that time. It is also said that the statement to be submitted may show that the net earnings of the 12 months in question will be over $8,000,000, a sum more than sufficient to pay for all the improvements of the Western Union Building, repair the losses caused by the spring storms, and leave a profit of more than eight per cent. on the stock.

Output of Bell Telephones.—The American Bell Telephone Company reports the following output of telephones for the month ending July 20, and these comparisons for the period since Dec. 20.

Month ending July 20:	1891.	1890.	Inc.	Dec.
Gross output	4,699	4,787	.....	88
Returned	4,638	2,887	1,751	.....
Net	61	1,900	.....	1,839
Since Dec. 20:	1890-91.	1889-90.	Inc.	Dec.
Gross	42,623	38,364	4,259	.....
Returned	23,399	14,991	8,408	.....
Net	19,224	23,373	.....	4,149
Instruments in use July 20	500,854	467,114	33,740	.....

Bell Telephone Stock.—The Boston *News Bureau* says that the late decline in Bell telephone stock of about seven points to 186 has been due to stockholders in New Bedford selling long stock to re-invest in Cleveland and Canton five per cent. gold bonds at 80, with a bonus of 50 per cent. in the preferred stock. The authorized issue of these bonds is $1,000,000, and all but $200,000 have been sold. New Bedford people are large holders of Bell telephone stock and also have the controlling interest in the Cleveland and Canton. Of this remark the Boston *Herald* says: "This explanation of the decline of telephone stock appears rather strained and quite unnecessary. This decline began some time since, and was emphasized in appearance by deducting the nine points of regular and extra dividend. Any further decline is adequately explained by the state of the general markets, and possibly by selling against the near maturity of important patents. The business of the company will have to come down from a patent monopoly to a competitive commercial basis in time, and none should be aware of this more fully than shareholders. It will be entirely natural for shareholders to part with more or less of their holdings before the stock sells ex the patent rights." On Friday of last week American Bell Telephone stock opened in Boston at 183, a gain of 1½ points over Thursday's closing price, and kept descending to 175. There was little improvement after this, and at noon it had climbed back to 177, the transactions to that hour amounting to 672 shares. Early in the afternoon the stock made a slightly better showing and closed at 180. It may be interesting to see how this price of Bell Telephone compares with a few other recent periods. The showing is as follows: Jan. 24, 1890, 213; May 24, 1890, 236; Jan. 24, 1891, 204; Feb. 24, 1891, 191; March 24, 1891, 198; April 24, 1891, 205; May 25, 1891, 200; June 24, 1891, 201.

The Closing Quotations of electric stocks on Saturday, July 25, 1891, in New York and Boston were:

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
NEW YORK.				
Western Union Telegraph Co	100	86,200,000	79⅝	79¾
American Telegraph & Cable	100	14,000,000	....	80¾
Central and South American	100	5,000,000	130	140
Mexican	100	2,000,000	200	215
Commercial Cable Co	100	7,716,000	104½	106
Postal Telegraph Cable	100	5,000,000	....	....
Edison General Electric	100	9,503,500	101¾	103
" " Deferred....	100	2,496,500	....	....
Consolidated Electric Light	100	1,929,400	....	....
Edison Electric Illuminating Co	100	2,567,800	....	....
United States Electric Light	100	1,500,000	....	....
North American Phonograph	100	6,200,000	....	....
BOSTON.				
Thomson-Houston Electric Co	25	6,000,000	39	39½
" " preferred..	25	4,000,000	24¼	24¾
" " Series C....	10	400,000	....	....
" " Series D....	10	120,000	6¾	....
" International Co	100	1,000,000	....	....
Thomson Welding Co	190	1,000,000	....	....
" European Welding Co	100	1,000,000	....	....
Ft. Wayne Electric Co	25	4,000,000	11½	....
Westinghouse Electric Mfg. Co	50	5,000,000	....	124
Telephone:				
American Bell	100	12,500,000	178	179½
Erie	100	4,800,000	48	48¾
New England	100	10,304,600	49	....
Mexican	10	1,280,000	1.07	....
Tropical American	10	400,000	....	....
Edison Phonograph Doll	10	1,000,000	¼	⅝

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe Street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

TELEPHONE STOCKS.

Chicago	$230@ $240	Cumberland	$60@ $62
Central Union	52@ 53	Wisconsin	118@ 120
Michigan	83@ 84	Bell of Missouri	160@ 165
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell	40@ 43		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$95@ $100	Chicago Edison Co	$145@$150

NEW INCORPORATIONS.

The Artelectro Company, with a capital stock of $1,000,000, has been incorporated at Cleveland, Ohio, to manufacture and sell electrical devices of all kinds. The promoters are N. S. Amstuz, George Hoyt and C. W. Foot.

The Merchants' Electric Light Company, of Leavenworth, Kan., has been organized, with a capital stock of $50,000, to manufacture and supply electric lights. The incorporators are J. H. E. Wiegant, W. B. Walker, and E. Michael.

The Cutter Electrical and Manufacturing Company, of Camden, N. J., has been incorporated, with a capital stock of $100,000, to manufacture electrical, chemical and mechanical novelties and appliances. The incorporators are N. B. Cutter, E. Cobbe, E. M. Dobelbower, all of Philadelphia.

The Jenney Star Electric Company, of New Bedford, Mass., has been organized with a capital stock of $50,000 by Mr. James A. Jenney, who organized the Fort Wayne Electric Company in 1880. The company will manufacture, it is said, an entirely new dynamo, the invention of Mr. Jenney, as well as other electrical supplies.

The Harrison Street & Desplaines River R. R. Company, of Chicago, has filed articles of incorporation in the office of the Illinois Secretary of State. The capital stock is $112,500, and the incorporators and directors are the following real estate men and attorneys: E. L. Stewart, S. G. Swisher, G. Grant Stewart, H. H. Ingham and Walter B. Phister.

The Light, Heat and Power Company, of New Albany, Ind., with a capital stock of $50,000, was recently incorporated for the business of purchasing, establishing, erecting and maintaining an electric light station, etc., to furnish light, heat and power to all persons desiring to use the same in Floyd and Clark counties. The promoters are Marcus Ruthenburg, John S. Briggs and Otto Hoffman.

The Fairmont Development Company, of Fairmont, W. Va., with a capital stock of $600,000, has recently been started for the purpose of establishing a town for manufacturing, mining and dealing in lumber, coal, iron, brick and oil, constructing electric, gas and water plants, and operating the same for shops, etc. The incorporators are O. S. McKinney, G. L. Smith, C. W. Amett, J. E. Watson and S. L. Watson.

The United States Bulletin Company (incorporated in West Virginia) has just been started in New York with a capital stock of $200,000, to manufacture, sell, rent, etc., electrical or mechanical bulletins, etc., to report base ball games and other amusements, sporting or public events. The promoters are: M. D. Compton, Newark, N. J.; J. N. White, Tottenville, N. Y.; A. H. White, Red Bank, N. J.; O. S. Woodruff, Newark, N. J., and J. Fred. Glasby, Elizabeth N. J.

AFFAIRS OF THE COMPANIES.

The Milwaukee Electric Plating and Manufacturing Company, doing business on Clinton street, Milwaukee, recently made an assignment to William Frackenberg, who qualified in the sum of $1,500.

Sale of Attica (N. Y.) Company Postponed.—The sheriff has received notice to postpone the sale of the Attica electric light plant, which was to have taken place last week, until Sept. 3. The postponement is in accordance with an order issued by Judge Daniels.

The Dedham (Mass.) Electric Light Company at its recent annual meeting elected the following officers for the coming year: John R. Bullard, president; Thomas T. Robinson, secretary and treasurer. The directors are Frederick D. Ely, Dr. John W. Chase, Albert W. Nickerson, John R. Bullard and Thomas T. Robinson.

Westinghouse Reorganization.—The financial column of the Boston *Advertiser* contained the statement last week that Charles Francis Adams, the largest New England stockholder of the Westinghouse Electric and Manufacturing Company, and one of the recently elected directors, is intended for the president of the company, but that it is doubtful if he would stand in the way of the re-election of Mr. George Westinghouse.

The New England Telephone and Telegraph Company has declared a dividend of 75 cents per share, payable August 15, to stockholders of record July 31. The books will be closed from August 1st to the 14th inclusive. It is announced that this com-

pany has discontinued giving out its quarterly statement of operations owing to a change of methods in keeping its accounts. Statements will hereafter be made but once a year.

Detroit Traction System Sold.—The entire Detroit street car system, it is reported, changed hands last week, Lawyers Waller, Cook & Wagner, of No. 15 Wall street, this city, representing a Boston and New York syndicate, being the purchasers. The system embraces over 80 miles of road and the price paid was over $5,000,000. The sale will end the war which has been going on there between the different companies, growing out of the extension of the charters of the various lines. The motive power will be changed from horse power to electricity. Mr. S. Harrison Wagner, of the foregoing named firm, is reported to have said: "My partners, ex-Gov. Waller and Mr. Cook, are now in Detroit completing the arrangement for the transfer. The deal was practically consummated last week. I am not at liberty to give the names of the gentlemen who are in the buying party. The change of ownership will take place at once. Governor Waller will return from Detroit to-morrow."

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
166-177 TIMES BUILDING, NEW YORK, July 27, 1891.

Mr. M. E. Clemons, of the Clemons Electrical Manufacturing Company, of Attleboro, Mass., was a visitor to New York last week.

Mr. Geo. W. Cleveland, representing the Forest City Electrical Works, of Geneva, O., has been in New York on a business trip for the last few days.

Mr. John I. Drake, of Messrs. Drake, Payson & Whittier, of Providence, R. I., was in New York City during last week. He reports that business is very good indeed in Rhode Island, with the prospect of a very large fall trade.

Mr. Elbert O. Jeralds, well known in steam railway circles, and for many years connected with the New York, New Haven & Hartford Railway Company, has opened offices at Rooms 38 and 39 Times Building, this city. He will handle a full line of electrical, steam and street railway specialties, among which will be the celebrated "Helmet" brand of woven insulated wire, manufactured by the New Haven Insulated Wire Company.

Mr. P. H. Brangs, electrical engineer for the D., L. & W. Railway, is supervising the erection of a new combination electric, gas and steam plant at Hoboken, N. J., which will be a model plant of its kind. There will be one main building of brick, with iron trusses and roof, the different departments being divided as follows: For gas plant, 42 × 47 feet, with 25 feet extension, and one large gasholder; for boiler plant, 65 × 40 feet; for dynamo room, 40 × 40 feet. The gas plant will have a capacity of furnishing 24,000 cubic feet daily, which is sufficient to light 500 passenger cars. This system is known as the "Pintsch" system of lighting, the gas being manufactured from crude petroleum. The boiler-house will have a capacity for two batteries of four 100-h. p. boilers each. They are to be horizontal, forge steel, tubular type, 66 inches in diameter by 16 feet long; $\frac{3}{8}$ and $\frac{7}{16}$-inch plate being used in constructing them. There will be two independent stacks, one for each battery. The stacks will be of heavy iron, and so constructed as to be self-supporting, no guy wires being necessary. This not only makes a more substantial structure, but is also more pleasing to the eye. The stacks will be anchored to a solid brick foundation 20 feet high, the stacks being 80 feet, making a total height of 100 feet, thus insuring a perfect draught for the poorest grades of coal without the use of artificial draught. These boilers will furnish the steam for heating the cars while in the station, for running two gas-compressing engines, and also for running three 100 h. p. engines for electric lighting. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.,
BOSTON, Mass., July 25, 1891

The Belfast Electric Light and Power Company contemplates purchasing the present local gas plant, to run in conjunction with its present electric-light plant.

The Russell Electric Company, has been increasing its facilities for the manufacture of the Russell arc lamps, a move made imperative by the recent increase of business.

The electric light, gas, water and street railway companies of Bangor, Orone, Veazie and Old Town, Me., have consolidated under the title of The Public Works Company.

Effects of the Lynn Fire.—During the disastrous fire at Lynn, Mass., it was found necessary to cut all the wires of the Lynn electric street railway. The delay to traffic was of short duration, however.

Messrs. J. A. Grant & Co. report the sale of two tandem compound McIntosh & Seymour engines of 250 h. p. each, to the Gloucester Electric Light Company. These engines are designed to be run with an intermediate shaft between them, belting direct to dynamos therefrom.

The Wainright Manufacturing Company has just placed six large expansion joints in the West End Street Railway Company's new power house, making 20 altogether now in use by this company. It has also recently shipped two 600 h. p. compounded railway heaters to the Denver street railway company.

The Eastern Electric Supply Company has just put in a 15 h. p. Card motor for Messrs. Hunt & Blont, of Boston, which runs all their machinery on the six floors. This company reports the sale of 10 electric snowplows so far this year, and the equipment for the Lawrence, Mass., electric street railway.

The Thomson Electric Welding Company is busy making more machinery for the Johnson Company, of Johnstown, Pa. Since April, 1890, the latter company has installed or ordered the following machines: One for making combination splice bars which were previously made by shearing, an expensive process, because of waste of metal; two, for welding chairs for street railway construction, previously made by drop-forging in two parts and riveting together, but now rolled and welded, making a solid rail chair, in one piece; a large machine for welding a metallic tie to take the place of the ordinary wooden tie, besides many others. To run these machines the Johnson company has erected a dynamo building 100 feet long, containing several engines, one 90 h. p. Ball, three 150 h. p. Ball engines, two 150 h. p. Greenes, and one 300 h. p. Ball. The dynamos they run are one 40,000 watt machine and seven 80,000 watt machines, all so arranged that it will be easy to provide a large increase. A large hydraulic plant has also been installed.

The Rapid Transit Commission appointed by the Mayor to devise some system of transportation of passengers which will relieve the immense traffic is now established in its offices in the new Exchange Building. A committee has been appointed to go to London, Paris and Berlin to make a thorough examination of the systems adopted by those municipalities, in order to select that best adapted to the needs of Boston. The West End Company stands ready to work with the city in every way, but, as President Whitney says, there is a limit to surface transportation with the crowded condition of many of our streets, and that limit so far as applies to the number of cars possible to run has nearly been reached. This company is extending its electric lines wherever possible. The company has put on a great many large cars with a seating capacity of 40 people, but the wonderful increase in travel has more than kept pace with the increased facilities for handling the traffic, and hence the Rapid Transit Commission. It will be remembered that the West End Company has been granted a charter for an elevated road, and President Whitney has submitted a plan and route on which to build it. This plan necessarily contemplated a few changes in some of the streets, requiring a large expenditure both for the company and on the part of the city, and as yet nothing has been done. It is not unlikely that this will be utilized, in part at least, by the commission. In any case, whether an elevated or underground system is adopted, electricity will undoubtedly be the motive power used. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 The Rookery, Chicago, July 25, 1891.

Mr. C. P. Russell, of the Brush Electric Light and Power Company, at Galveston, Tex., visited the supply houses in Chicago this week.

The Wisconsin State University has received from the National Electric Company of Eau Claire a gift of a 30-light incandescent dynamo.

Mr. Elmer P. Morris, of the railway department of the Thomson-Houston Electric Company, at Boston, is visiting various points in the West.

Mr. Frank Wunder, of The Rookery, Chicago, has secured the contract for installing the electric light plant in the Deaf and Dumb Asylum at Indianapolis, Ind.

Mr. W. W. Griscom, president of the Electro Dynamic Company, of Philadelphia, was a welcome visitor in Chicago this week, returning from Dubuque to his home.

Fort Wayne, Ind.—Preparations are being made to lay pipes for conducting natural gas to the boiler-room of the Fort Wayne Electric Company to be used as fuel.

Mr. George Meeker, manager of the Chicago office of the New York Insulated Wire Company, is confined to his residence by illness but his friends expect to see him out again in a few days.

Mr. E. E. Keller entertained Messrs. Johnson and Wells, of the Northwest Thomson-Houston company, of St. Paul, and Mr. William J. Reilly, of the Evanston Illuminating Company, at the Electric club rooms this week.

Mr. W. H. Fairclough, well known to all electric light men in the West through his long connection with the Edison and the Westinghouse companies, is now in charge of the isolated lighting department of the Chicago Edison Company.

Electrical Engineer Sargent tendered his resignation to Chief of Construction Burnham last Tuesday, but he was induced to withdraw the resignation, and has agreed to remain with the department until the close of the World's Fair. Mr. Sargent's reason for tendering his resignation was that the combined duties of his private business and his World's Fair work were too onerous.

Mr. S. G. Booker, manager of the Fidelity Carbon Manufacturing Company, of St. Louis, Mo., was a welcome visitor in Chicago, this week, and returned home with some handsome orders in his pocket, one being the largest order of the kind ever given. Mr. Booker said his factory was kept busy with the orders received for battery carbons, one of the latest orders calling for carbon boxes 14 × 7 × 9 inches.

Electricity to the Rescue.—On the occasion of a recent fire the Cicero & Prariso Electric Railway Company rendered excellent service by allowing the village hose carts to be attached to its motor car and drawing the same to a point near the burning building, thus saving several minutes. The appearance presented by the hose cart as it bounded along on the ties can be easily imagined, but "it got there all the same."

D. H. Burnham, chief of construction of the World's Columbian Exposition, 1143 The Rookery, has called for bids to be presented before 1 P. M., August 3, for two 50-light arc machines complete; one direct current incandescent dynamo, complete, and one 80,000-watt, 500-volt compound wound generator for power circuits, with such motors as may be necessary. The above apparatus to be rented to the exposition managers until January 1, 1893.

Mr. C. Kammeyer, superintendent of the National Electric Manufacturing Company, Eau Claire, Wis., was a welcome visitor in Chicago this week. In referring to the large amount of business his company is transacting he mentioned the orders received from the Elgin (Ill.) Insane Asylum for three 650-light direct current machines; a 400-light direct current dynamo for the R. S. Dickie Manufacturing Company, Elgin, Ill., and three 2,000-light alternating current dynamos for the Lincoln Gas Company, the Eau Claire Street Railway Company and Armour & Co., Chicago.

Mr. E. L. Babcock, president of the Falls Rivet and Machine Company, Cuyahoga Falls, Ohio, is one of the welcome visitors in Chicago this week. Mr. Babcock reports an abundance of contracts for clutch pulleys and shafting, and expects to have several large contracts completed within the next thirty days. Mr. Babcock mentioned the great interest that is being shown in the success of the Montreal Convention, where his company will turn out in full force.

A Good Location for an Electrical Factory.—The Chicago Heights Land Association owns a large tract of land of more than 300,000 acres in the southeastern part of Cook County, Ill., not more than 10 miles from the city limits of Chicago. It is finely located, being over 100 feet higher than Lake Michigan. Access to the centres of business in Chicago is excellent. Chicago Heights has the same freight rates to and from all points as Chicago, and easy access to 38 railway systems. Artesian wells have been sunk, and it is said that water is abundant. Electric light and waterwork plants are being projected. Building material is easily accessible at market prices. Manufacturers of engines and electrical machinery could hardly find a more suitable place to establish a factory in the central West, and will be well repaid for any investigations they may choose to make with a view to locating there.

Edwin Lee Brown, president of the Electric Illuminating Company, of Chicago, died of heart disease at his residence in this city, on Tuesday morning, July 21. Mr. Brown was born in Milo, Me., March 4, 1827, and moved to Chicago in 1855, since which time he has been untiring and zealous in promoting the best interests of the city. He has been the president of the Citizens' Association, and was probably the first one to advocate holding the World's Columbian Exposition in Chicago. But his name will be cherished longest in connection with the excellent work he has done as president of the Illinois Humane Society and of the International Humane Association, where his broad-minded and philanthropic views and his high executive ability contributed so largely to the succesful operations of both societies. Mr. Brown leaves a widow and four children. F. DE L.

SOUTHERN NOTES.

NORFOLK, Va. July 25, 1891.

St. Augustine, Fla.—The Alcazar Hotel is to install in an electric light plant.

Leroy, Fla.—Parties are contemplating the erection of an electric light plant here.

Franklin, Va.—An electric light plant will be erected in this, city by the Edison General Electric Company.

Pass Christian, Miss.—Messrs. Shaffer Bros. are to install an electric light plant in their Ardoyne sugar house.

Tampa, Fla.—The incandescent plant of the Tampa Illuminating Company is to be changed to an arc system.

Aiken, S. C.—The Carolina Light and Power Company has elected B. F. Turner as president and Alvin Etheridge secretary.

Baltimore, Md.—Mr. Jacob Pope has purchased the old grist mill on the Frederick road, and will establish an electrical plant.

Bramwell, W. Va.—The Bramwell-Pocahontas Electric Light Company has improved its plant by the addition of new machinery.

Washington, D. C.—The Chesapeake and Potomac Telephone Company has declared a dividend of 75 cents per share, payable on July 27, 1891.

Shreveport, La.—Mr. J. Wise, representing a syndicate of capitalists, has petitioned the City Council for a franchise to erect an electric light plant.

Nashville, Tenn.— The building for the poor and insane of Davidson County will be supplied with an electric light plant. The plant will cost about $13,000.

Ellicott City, Md.—A proposition has been made the city for the establishment of an electric light plant. Mr. W. L. Nott is very much interested in the movement.

New Orleans, La.—The Enterprise Construction and Supply Company, which was recently incorporated, will erect electric light plants and construct water-works.

Greensboro, N. C.—The Greensboro Female College Association will put in an electric light plant. The contract has already been let. The cost will be about $8,000.

Atlanta, Ga.—A bill has been introduced in the state legislature to appropriate $10,000 for the purpose of putting in an electric light plant at the State Deaf and Dumb Asylum.

Chattanooga, Tenn.—An electric light plant will be built at Chattanooga by the Chattanooga Water and Electric Company, of Chicago, Ill. This company was recently incorporated.

Durham, N. C.—Mr. R. L. Flowers, a graduate of the Annapolis Naval Academy, has been appointed Professor of Electrical Engineering at Trinity College, to be opened this fall at Durham.

West Arlington, Md.—The West Arlington Telegraph, Telephone, Electric Light and Power Company has been incorporated with a capital stock of $50,000. The incorporators are R. G. Webb, C. G. Hill, John Cowan and others.

Galveston, Tex.—Noah Hamlet and W. D. Holtzman have been awarded the contract by the Galveston City Railroad Company for the erection of its electric plant, which will cost $50,000. The building will be 99 × 280 feet in size and four stories high.

Lynchburg, Va.—Two of the electric cars for the Rivermont Street Railway have arrived. These cars are from the shops of Lewis & Fowler, of Brooklyn, N. Y., and are fitted with the Edison motor and machinery. The power plant and connections will soon be completed.

Middlesborough, Ky.—It is reported that a party of Eastern capitalists will locate a plant at this place for the manufacture of electrical devices. The company wanting to locate the enterprise is a very strong one, and the citizens of Middlesborough will give it all the encouragement possible.

Atlanta, Ga.—The Moore vs. Western Union Telegraph Company case, which recently came up before Judge Miller, was decided in favor of the defendants. Mr. Moore was visiting in Atlanta, and having failed to receive a telegram which was sent him, commenced suit in Crawford's Superior Court against the company. Judge Miller, in handing down his decision, says: "A transient visitor to a town or city who furnishes to the company no definite address is not a person residing in the same or within one mile of the station, in contemplation of the act of 1887, subjecting telegraph companies to a forefeiture for failure to deliver dispatches to residents."

Washington, D. C.—Col. Ernst, one of the commissioners of the District of Columbia, is very much in favor of placing telegraph and electric wires underground. In speaking of the matter, he says: "Attention is again respectfully invited to the fact that it is becoming more and more difficult to operate the overhead telegraph system, owing to the fact that the trees along the line are gradually growing up into the wires. Not only are the present poles too short, but many of them are rotting at the butts, and are in constant danger of breaking or of being blown down during storms. The necessity for either replacing the overhead wires with underground cables or of replacing the present poles with taller ones is obvious." V. N. B.

CANADIAN NOTES.

MONTREAL, Can., July 25, 1891.

The Electrical Situation.—Just now the atmosphere in this beautiful and busy Canadian city is highly electrical. Its influence got into the finance committee of the city council and kept the members moving at such a rate that they decided to recommend the council to give the promoters of the great electrical convention the sum of $1,000. Here Mr. A. J. Corriveau, who, it is well known, is always on hand when hard work is to be done, appeared before them in person and pointed out the magnitude of the exhibition and suggested an increase, with the result that they altered their minds and made it $2,000. The entertainment committee met on Tuesday and transacted a lot of business. The question of entertainments was taken up and it was decided to hold a grand conversazione at the McGill University, the Redpath Museum and Lecture Hall being placed at the disposal of the committee by the Governors. This is a privilege seldom given to any body. The buildings will be decorated in first-class style in honor of the event. Visitors will have an opportunity of going to Lachine and shooting the rapids by special arrangement with the Grand Trunk Railway and steamboat companies. Arrangements will probably be made to have a grand lacrosse match played by the Indians, who are well able to illustrate in a practical manner how Canada's national game is

played. Among other pleasing anticipations, that of meeting the fair ones of this city at a grand ball on some evening during the convention will hold a good place, and I have it on good authority that either a banquet or ball will be given, either of which, it goes without saying, will be successful. So much for the entertainments. Mr. A. J. Corriveau informs me that a cablegram has been received from Messrs. Felton & Guilhaine, of Cologne, Germany, asking for space at the exhibition. They will get it. Mr. Corriveau is also anticipating exhibits by several other large firms in England and Germany. He is still working hard in the interests of the convention, as, indeed, are all those forming the various committees. Outside those immediately interested the general interest in the exhibition is growing rapidly. It is quite amusing, occasionally, to hear the different scraps of conversation that reach one's ears on the subject of electricity, and what the exhibition will consist of; for instance, in a down-town restaurant the other day, while talking to a friend on the subject uppermost, I heard a fair lady near by say, "Oh, yes; it's going to be just lovely. Speaking dolls, phonographs, lights, bells, and oh! everything, you know." Her friend nodded, so I suppose she knew. "Cirtcele."

ENGLISH NOTES.

London, July 15, 1891.

Chicago Exhibition.—The English government has nominated the Council of the Society of Arts a Royal Commission for the purpose of superintending art exhibits at the Chicago Exhibition, and has granted £25,000 toward expenses.

The Forthcoming Meeting of the British Association at Cardiff.—At the forthcoming meeting of the British Association at Cardiff it is proposed to hold a discussion on "units and their nomenclature," having special regard to the new electric and magnetic units now becoming necessary for practical purposes.

Train Lighting at the Cape.—In his report for the year 1890 the general manager of the railways of the colony of the Cape of Good Hope states that the electric train-lighting experiments inaugurated during the year proved a great success, so far as comfort to passengers and immunity from accident were concerned. With regard to the comparative expenses of lighting by oil and electricity, he is of opinion that the latter is decidedly more expensive, but goes on as follows: "Colza oil gives a wretched light, by which it is impossible to read at night with any degree of comfort. Paraffine gives a brighter light, but although we used the more suitable oil, there is great risk connected with the burning of this class of oil. . . . Several accidents have taken place, causing great risk to the passengers' lives and the safety of the carriages." The general manager concludes by recommending that electric lighting should be adopted throughout the Cape railway system.

Experiments with a Willans-Mordey Combination in Parallel.—Some interesting experiments were carried out at Messrs. Willans & Robinson's engine works in the beautiful river-side village of Thames Ditton, to disprove the suggestion which has been put forward that alternate-current dynamos cannot be run in parallel when they are driven by rigidly coupled high-speed engines. Mordey alternators, of by no means the latest pattern, and engines taken at random from stock, were coupled up in the presence of several well-known electrical engineers. The usual synchronizing arrangement of a pair of transformers and lamps in series was provided, and (as was evidently expected by both the designer of the dynamos and the maker of the engines) the machines fell into step and ran perfectly smoothly, both under light load and full load, and an output of about 3 k. w. was evenly distributed between the two machines, a Siemens dynamometer showing no perceptible flow of current between them. The steam was then almost entirely shut off from one engine. This engine takes about 25 pounds of steam to run it idle, but about four pounds was left on to keep the parts from lifting, since the connecting rods are usually in continual compression, the engine being single acting. The other dynamo took up the full load and drove the idle one as a motor, carrying the engine with it. Numerous other tests and experiments were made showing the error of the idea that a belt or rope connection is necessary for parallel working. Messrs. Willans & Robinson's engine works, which recently suffered very severely from fire, have now been rebuilt and present not only a most complete and systematized manufactory of the very highest class of steam engine, but there are always to be found in the erecting shop and testing departments a very varied assortment of dynamos by most of the leading makers in the country.

The Taxation of Invention.—For some little time there has been an increasingly vigorous agitation for the reduction of the cost of obtaining patents in this country and increasing the facilities afforded to the public by the Patent Office. These complaints culminated in a motion in the House of Commons yesterday evening, brought forward in an admirable speech by Mr. Leng, who insisted on the good policy of encouraging invention and deprecated the abnormally high fees charged in this country after the first few years. Taking the fees for the number of years in which patents exist in different countries, the average charge in each country is as follows: United States, 8s. 5d. per annum for 17 years; France, £4, 15 years; Great Britain, £11, 14 years; Germany, £17 10s., 15 years. The result of this heavy tax was, in Mr. Leng's opinion, to discourage invention in England. Instead of the Patent Office being a helpful promoter of inventions, it was, he said, "a hard, niggardly, unsympathizing tax collector." In conclusion the speaker urged those responsible no longer to look at this question merely from the manufacturers' or capitalists' point of view or even from the revenue point of view, but rather to take the broader view and reduce patent fees to the minimum sum compatible with the Patent Office being self-supporting. The President of the Board of Trade replied for the Government and took the line of argument which is generally held in this country, namely, that mere invention is not one of the chief sources of commercial prosperity and that to allow useless patents to lapse was in the end beneficial both to the patentee and to the public. The estimated surplus for 1891 was, he said, £116,000, and on the strength of this and of the almost equally large surplus of the past three or four years it was proposed to entirely reconstruct the Patent Office building at a cost of £130,000, and he was prepared to consider the advisability of extending the period of low renewal fees from four to eight years.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

Motor Designing.—What is the proper size of wire for a 2 h. p. motor, both for armature and field magnet, for a 110-volt current, current being supplied from storage batteries, and motor being somewhat like "Edison dynamo"? J. M. S.

Read the note at the head of this column.

Griscom Motor Ring.—Could you give me practical directions in your paper for winding a Griscom motor field magnet of a ring shape with two diametrically opposite, inwardly projecting poles? S. R. C.

Have the winding of the two coils alike in relation to the core, The magnetizing current must run in the same direction in both coils.

Magnetization of Discs.—Will you please tell me through your column of "Answers to Correspondents" if I can magnetize ½-inch discs, ⅛ inch in thickness, with six common Leclanché batteries, and if the faces will be the poles? G. B. S.

It would be impossible to have uniform permanent magnetism in such a disc. You can, however, produce poles on either side of the disc by surrounding it with a coil.

Tempered Copper Castings.—How can I make or cast commutator segments of copper? We get such pieces from North East, Pa., made by the Eureka Tempered Copper Company. They are harder than ordinary copper and very solid. F. G.

The casting of hard copper is a difficult undertaking and we would not advise you to attempt it. The process of the Eureka Company is a trade secret.

Telephone Induction Coils.—Will you kindly inform me in your "Answers to Correspondents" if an induction coil in a telephone used for private purposes—say for a distance of 500 to 600 feet—need be of the same resistance as that used in the standard exchange instrument? Please give me also the lowest resistance required in the secondary and primary coils. A. B. C.

No induction coil will be needed for such a short distance.

Parallel Working of Dynamos.—I am running a 600-light Thomson-Houston and 200-light Edison dynamo, which I want to run together on the same circuit. Will it do to connect both machines to the feeder board or to a 400-ampère switch? Is there not danger in making such connection of making a motor out of one machine? J. H.

It would be unwise to connect two different types of machines in the way you mention.

Electric Elevator Working.—(1) If a heavy load is placed on the platform of an elevator whose drum is geared direct to the armature shaft of motor, will not the elevator run the motor? (2) Assuming that such is the case, would a motor, either series or shunt wound, be generating current, and thus acting as a brake? (3) What are the coils around the faces of the poles of Thomson-Houston railway generators for? W. I. B.

(1) Yes. (2) It would not be a very satisfactory brake. (3) The coils you mention are the series coils of the compound winding.

Reversal of Polarity.—(1) How often does the change of polarity occur in an arc-light dynamo? (2) How long does the change generally last? (3) Do the men in charge of the dynamos reverse the current when the change occurs? A. C. S.

(1) The changes do not occur at stated intervals. If the machine has been lying idle for some days and receives a jar it may or it may not have its polarity reversed; or it may lose its magnetism altogether. (2) The time is indefinite. (3) It is best to bring about the original polarity by magnetizing the fields from a separate machine.

Galvanometer Deflections.—(1) Are the deflections of the light beam of the Thomson reflecting galvanometer exactly proportional to the current flowing through the galvanometer coils; that is, if a certain current gives a deflection of 100 scale divisions, will exactly double the current give exactly 200 divisions? (2) If the light beam deflections are not strictly proportional to the currents through the galvanometer coils can perfectly accurate results be had when working with a constant as in tangent galvanometer work? A. T.

(1) The deflections are very nearly proportional to the current and only begin to deviate perceptibly when the angles of deflection vary considerably. Within the working range generally used the relation is sensibly exact; it is better on general principles to use null methods whenever possible, and when this is impracticable so to adjust the apparatus that deflections shall not vary widely in magnitude. This can nearly always be done by shunting the galvanometer. (2) Virtually answered by the reply to previous question. The constant can be used without sensible inaccuracy if the angles of deflection are small.

Induction Coils.—Please answer the following questions and greatly oblige a subscriber: (1) Why is it necessary to insulate the several layers of wire of an induction coil from each other any more than the several turns or convolutions of each layer? (2) Would a small wire covered with pure india rubber of reasonable thickness need any further insulation when used as the secondary wire of an induction coil of sufficient strength to give a four or five inch spark? (3) How is the E. M. F. of a coil calculated? (4) About what is the voltage required to cause the current to jump a gap of four to six inches in the circuit? (5) Can you furnish a work clearly explaining how to wind or construct a dynamo or motor for any required voltage and ampère capacity? Also an exhaustive work on induction-coils? O. J. S.

(1) Because the difference of potential between any two layers is greater than between any two convolutions of the same layer, and the greater the difference of potential the greater the liability of leakage. (2) No; but such wire would be difficult to wind without injury to the coating. (3 and 4) The calculation is a complicated undertaking, and we can give no simple formula for the determination of the E. M. F. required. (5) Would refer you to Carl Hering's "Dynamo Electric Machinery," and Bottone's "Instrument-Making for Amateurs."

News of the Week.

THE TELEGRAPH.

Silver City, Ida.—The new telegraph line from Caldwell to Silver City is now completed and in working order.

San Francisco, Cal.—A franchise has been granted to the Western Union Telegraph Company to maintain its wires in the public streets. The company has heretofore acted without legal right.

New Orleans, La.—The city has refused to permit the Postal Telegraph Company to place its wires underground, and has also refused a permit to use high towers for the wires. Evidently New Orleans must have telegraph poles or nothing.

Cable Connection with Chili.—The American cable steamer Relay, belonging to the Central and South American Cable Company, has joined the cables in the free sea, off Iquique, re-establishing communications between Callao, Peru, and Valparaiso, Chili. The work was done under the protection of the U. S. S. Baltimore.

Military and Old-Time Telegraphers' Convention.—The Eleventh Annual Reunion of the Society of the United States Military Telegraph Corps and Old-time Telegraphers' Association will be held in Washington, on Aug. 19 and 20. The headquarters will be at the Ebbitt House. The business meetings of the Old-Time Telegraphers' Association will be held on Aug. 19 at 10 A. M., and that of the United States Military Telegraph Corps at 2 P. M. of the same day. On Aug. 20 the united societies will visit Mount Vernon, the Capitol, museums and other objects of special interest. A loan exhibition of historical telegraphic relics will be made in connection with the reunion. Among the exhibits is a letter from Samuel F. B. Morse to Henry J. Rogers, thanking him for a letter from Mr. Sanders in London, which treated of the superiority of the Morse instrument over the Wheatstone instrument, as then (1845) exhibited in London.

THE TELEPHONE.

Pennsylvania Extensions.—It is not unlikely that the Pittsburgh telephone system will be extended through Cresson to Altoona.

Des Moines, Ia.—The Central Union Telephone Company has notified the City Council that it accepts the franchise recently passed by that body.

Chattanooga, Tenn.—Manager H. O. Rhode, of the Telephone Exchange, is to be relieved of a part of his duties by the appointment of a chief operator and assistant.

Hill City, Tenn.—The establishment of telephone service, which has been discussed for some time, has been given up. This report is given out by Manager H. O. Rhode, of the Telephone Exchange in Chattanooga, Tenn.

Knoxville, Tenn.—The central office of the Knoxville Telephone Company has removed to its new handsome quarters on Vine street. This change was made necessary by the rapid growth of the list of subscribers during the past year. The new office is to accommodate 2,500 patrons. Twenty thousand dollars was expended in fitting up the new building.

THE ELECTRIC LIGHT.

Roseburg, Ore., is soon to be lighted by electricity.

Napanee, Ind., is agitating the electric light question.

Galion, O., will vote to issue $10,000 bonds for an electric light plant.

Gallipolis, O., voted on July 28 on the question of securing an electric light plant.

Albina, Ore.—The city's incandescent lights have all been exchanged for arc lights.

Homestead, Pa.—The Borough Council has decided to light the town by 35 arc lights of 2,000 c. p. each.

Dallas, Tex., will receive proposals until Aug. 4 for an electric light plant of 500 2,000 c. p. arc lights capacity.

Portland, Conn., has voted to light its principal streets by electricity for ten years at a cost of $125 per month.

Mount Pleasant (Ia.) has granted a charter to the Wheel Scraper Company to erect a municipal electric light plant.

Chester, Ill.—The Southern Illinois Penitentiary will receive bids until Aug. 11 for an electric light plant for lighting the prison.

San Antonio, Tex.—The Council Committee on gas and water has under consideration the erection of four new electric light towers.

New Market, N. H.—The electric light company, recently organized, is negotiating for the establishment of a local electric light plant.

Grand Haven, Mich.—Work on the electric light plant is progressing rapidly and it is probable that the town will be illuminated before October.

Valparaiso, Ind.—A complete incandescent lighting plant is to be installed by Mr. J. W. Stratton, the proprietor of the electric light and gas works.

Wardner, Wash.—The arc lights first to be placed in position in the Cœur d'Aèlne country were illuminated for the first time in the latter part of July.

Marion, Ill.—The electric light company has organized by the election of Mr. J. M. Burkhart as president, and Mr. J. W. Westbrook as vice-president.

The Stevens Point (Wis.) Lighting Company has purchased the new plant recently installed by the Excelsior Company, of Chicago, Ill.

Buchanan, Mich.—A special meeting was called last week for the purpose of bonding the village for $50,000 for the purpose of installing a system of electric lights.

Venice and Madison, Ill.—The Niemann Electric Light Company expects to have its plant in operation for the lighting of these towns during the early part of the present month.

Grand Rapids, Mich.—The Common Council has been considering the question of electric lighting for the city, and has recently visited Detroit to inspect the tower system in use there.

Springfield, Ill., has granted a franchise for an electric light plant to the Citizens' Light and Power Company. The company is to furnish the city with 2,000 c. p. arc lights at the rate of $75 per year per light.

Crawfordsville, Ind.—The new electric light plant will be in operation by the 15th of the present month. The municipal contract with the Crawfordsville Water and Light Company will not expire until that time.

Erie, Pa.—The Erie City Iron Works has let a contract to the Duplex Electric Company, of Corry, Pa., for an extensive electric light plant. The shops and surrounding territory are to be supplied from the station.

Knightstown, Ind.—The Council has awarded the contract for lighting the streets to the Thomson-Houston Company. The town is to have 70 lights, to burn until 12 o'clock each night, at a cost of $70 per lamp per year.

Memphis, Tenn.—The city Lighting Committee reports recently recommending that the City & Suburban Railway Company be required to erect electric lights along its line at street intersections, as required by its contract.

Aurora, Mo.—Messrs. Brewster & Co. have begun work on the new electric light plant, and state that the station will be in running order this summer. The building is to be of brick, 40 × 60 feet, with a capacity of 1,500 electric lights.

Youngstown, O.—Sealed proposals will be received by the City Commissioners until 12 o'clock noon August 10 for the lighting of the city, the contract to take effect on November 26 next. H. W. Calvin is the clerk of the board of commissioners.

Carlisle, Pa., has closed a contract with the Carlisle Gas and Water Company for furnishing the municipal lights for the following year. The cost is to be $96 per annum per lamp of 2,000 c. p. The town is to use 42 lamps to burn from dark to daylight.

Tampa, Fla.—Mr. R. Mugge is making some radical changes in his electric light plant. The dynamos at present in use will be

taken out and two new Thomson-Houston arc light machines of 50-light capacity each will be installed instead.

Weedsport, N. Y.—The electric light plant recently installed by the Thomson-Houston Company is to be sold to the village, provided a majority of the votes of the taxpayers is obtained.

A Large Contract Awarded.—The contract for the electric light plant for the Masonic Temple in Chicago, which will be one of the largest isolated plants in the world, has been awarded to the Western Isolated Lighting Department of the Thomson-Houston Electric Company. The generating plant will consist of six 80,000 watt generators and between 7,000 and 8,000 lights will be wired. Competition for this contract was unusually keen, nearly every company on the field having made proposals, and the Isolated Department of the Thomson-Houston Company naturaly feels elated at its success, particularly as, in addition to the generating plant and wiring, an order was secured for 8,750 Thomson-Houston incandescent lamps and the necessary sockets.

Exhibitors at Montreal.—The committee on exhibits, of which Mr. James I. Gulick is chairman, has issued a notice to intending exhibitors at the Montreal Convention of the National Electric Light Association, stating that a charge of 30 cents per square foot for space has been fixed upon as necessary to cover the expenses incident to the exhibition. Exhibitors must take charge and care for their exhibits and their display, provide all equipment and appurtenances except chairs, and assume all expenses on account of their exhibits. One-half the charge for space is payable upon acceptance of the awarded space and the remainder not later than the first of September. The obtaining of the power necessary for any of the exhibits has been left to the exhibitors individually. McGill University at Montreal offers to furnish several hundred horse-power at the cost of operating expenses. For small powers it is expected that an arrangement can be made to obtain what is needed from the plant at the Windsor Hotel adjoining the exhibition building. No duty is to be paid upon exhibits except in case of sale.

An Arc Plant in a Stone Quarry.—The firm of Dolese & Shepard, contractors and stone quarry owners in Illinois and Wisconsin, has recently installed an arc light plant of the Thomson-Houston system at their quarry at Hawthorne Station, Ill., for the purpose of facilitating the quarrying of stone at night. Twenty-five Thomson-Houston double-carbon standard arc lamps are used for the purpose and are suspended from poles mounted on movable standards, so that while blasting is in progress the lamps may be moved back from the edge of the quarry pit. The owners state that since putting the plant into operation they have not only largely increased the output of the quarry but that the men working at night turn out more stone per man than those working during the day. This is probably due to the fact that the men working at night do not suffer from the heat to so great an extent as those employed during the hours when the sun shines.

A Novel Isolated Arc Plant.—The new Chicago *Herald* Building has placed an order with the Western Isolated Lighting Department of the Thomson-Houston Electric Company for a plant consisting of one 10,000 and one 15,000 watt arc dynamos with 50 double carbon arc lamps, which will be novel in some respects. Special permission was obtained from the city electrician for the concealing of the arc light wires in this building, and a high grade of rubber covered wire will be used, protected by interior conduits, and laid in the concrete flooring. A circle of six lights will be placed on the flag staff, so arranged that they can be raised or lowered at will with perfect ease by one man. Special fixtures for suspending the arc lamps, a number of which will be placed on the front of the building, have been designed, and the wires leading to these fixtures will be brought through the building front. In order to accomplish this it will be necessary to drill in some places through five feet of brick and terra cotta, and in other places through about three feet of solid granite.

The Exhibit at Montreal.—Plans for the exhibit at Montreal under the auspices of the National Electric Light Association are reaching a definite and most satisfactory shape, and very gratifying response has been had to the various circulars sent out by the committee on exhibits. It is their intention to proceed at once now to subdivide the space and award the same, with a view to giving the exhibitors as much time as possible in which to make their preparations. The great interest taken in this exhibit is shown by the fact that while the floor space is five times as great as that used at any other convention exhibition, yet the applications for space have been in excess of that available. It is hoped that the Governor-General of Canada will open the exhibit, starting the machinery in motion. Plans will be made for music afternoons and evenings, special features in decoration will be carried out, and the Canadian members of the Committee on Exhibits promise great interest from their countrymen and a very large attendance. In view of the many new and pleasant features which will be held at Montreal, a very large number of the members of the association propose to attend the convention with their families, and already the hotels of Montreal are flooded with applications for quarters.

THE ELECTRIC RAILWAY.

The Middletown (Del.) Electric Street Railway is to establish a branch line to Odessa.

Driftwood, Me.—The electric street railway from here to Stroudwater will be completed in about two weeks.

Mt. Vernon, N. Y.—The Board of Trustees has granted a franchise for an electric railroad to the Fairchild-Ewing Company.

Providence, R. I.—Work has begun upon the new electric street railway which is to connect Providence with Pawtucket.

The Augusta (Ga.) Railway Company has purchased 12 additional electric motors of 25 h. p. each. These are to be used on the Summerville line.

Schenectady, N. Y.—The electric street railway company has asked permission to extend its line from the present terminus on State street to the city limits.

Pelham, N. Y., has granted a franchise to the Westchester Electric Railroad Company to operate an electric railway beween City Island and Yonkers by way of Mt. Vernon.

St. Paul, Minn.—It has been proposed by Mr. T. B. Walker and Col. Goodrich, who have extensive property interests westward, to install an electric railway to run to Lake Minnetonka.

The Braddock (Pa.) and Turtle Creek Electric Railway Company began operations last week on a portion of its lines. The complete system will be in operation the first part of the month.

Louisville, Ky.—The Louisville Railway Company has bought 10 double 15 h. p. "S. R. G." Thomson-Houston motors and car equipments, to complete the outfit of the Market and Shelby street line.

The Allentown-Bethlehem (Pa.) Electric Railway Company has offered $15,000 for the Rittersville Hotel property in Allentown, including a grove, intending to lay it out for a park or summer resort.

Portland, Me.—The changing of the old tramway to an electric system has been completed, and the road is now running smoothly with nearly twice the traffic as with the old system. The management reported 27,000 fares collected on July 4.

Orange, N. J.—The Essex County Electric Light Company has purchased an $8,000 site fronting the Delaware, Lackawanna & Western Railroad, upon which it will erect a fireproof building for a new power station to be used instead of the present one.

Leavenworth, Kan.—Mr. C. B. Humphrey, Omaha agent of the Edison company, was in the city last week in consultation with local capitalists regarding the proposed electric street railway. The scheme is being pushed by its promoters and no doubt the road will be installed before the fall.

San Francisco, Cal.—The San Francisco and San Mateo Construction Company has purchased a $200,000 site for its new power station. President Joost of the company states that a part of the tract will be subdivided and sold, and part reserved for a public park to be laid out by the company.

Thomson-Houston Railway Business.—The Boston *News Bureau* says that two months ago the Thomson-Houston Company had orders for 1,000 street railway motors ahead of its deliveries. The company has since been turning out and delivering about 70 motors per week, but to-day the orders are 1,100 motors ahead of the deliveries.

The Buffalo Street Railway Company is now running in an excellent manner. This road is equipped with the Edison electric system and the power plant is an unusually fine one, using the latest designs in Babcock & Wilcox boilers, Roney stokers, Ball and McIntosh & Seymour engines and Burpee's patent American fuel economizers.

Mr. C. B. Osgood, who has been connected with the Chicago office of the railway department of the Westinghouse Electric and Manufacturing Company since that corporation entered the street railway business, has gone to the South, where he expects to remain for some time in the interest of his company. His headquarters will be Atlanta, Ga.

A Pittsburgh Electric Railway Consolidation.—A deal has been consummated between the Pittsburgh & Birmingham Company and the Knoxville Land Improvement Company by which the Mt. Oliver Inclined Plane and the Knoxville Inclined Plane together with the proposed Birmingham hilltop lines of the respective companies are to be consolidated.

Attleboro, Mass.—Work has been commenced on the Interstate Street Railway, an electric line connecting North Attleboro, Attleboro, Pawtucket and Providence, which will operate between 20 and 40 miles of road. The Clemons Electrical Manufacturing Company, of Attleboro, of which Mr. M. E. Clemons is treasurer and manager, has the entire contract for building the road.

Pittsfield, Mass.—The trouble existing between the city officials and the railway company has been practically settled, the majority of the aldermen having signed the permit to operate the road, and at present vestibule cars are running a distance of three miles, leaving each terminus twice in an hour. The system used is the Westinghouse and the plant in operation is one of the best running that this company has yet installed.

Danville, Ill.—The City Council has been having a controversy over an electric street railway franchise. William P. Cannon, the banker, ex-Congressman J. G. Cannon, and A. C. Daniel, of St. Louis, and others have a charter for replacing seven miles of mule railway with an electric system; they have bought their material and put men at work to relay the track. The City Council, however, has construed the ordinance in such a way that the company has stopped work.

Grand Rapids, Mich.—Commencing August 1 the Consolidated Street Railway Company will operate the lines of the Street Railway Company of Grand Rapids and the Valley City Street and Cable Railway Company, of Grand Rapids. The capital stock of the new company is $2,000,000, and its officers are: A. J. Bowne, president; J. R. Chapman, vice-president and general manager, J. M. Hagar, secretary; James Blair, treasurer; B. S. Hanchett, Jr., assistant secretary and treasurer. The number of miles of electric road in operation at present is 12; of cable road, 10; of horse road, 18. It is the intention to equip all the lines with electricity as soon as possible.

The Pittsburgh Underground Electric Construction Company has been organized at Pittsburgh to equip electric and cable street railways with the underground system, under patents granted to Mr. John J. Miller, of that city. The officers and directors selected were Mr. C. D. Robbins, a successful oil producer of Washington County, as president; Mr. D. J. Rex, manufacturer, of Pittsburgh, as secretary and treasurer; Mr. C. F. Shoemaker, superintendent, of Ligget Spring and Axle Company; Mr. E. A. Mann, nut and bolt manufacturer, of Cleveland, O.; Mr. F. J. Osterling, architect, and Mr. John J. Miller, of the Robbins Electric Company, the inventor of this system, comprise the directory. The company is organized with a capital stock of $300,000, of which $96,000 has been paid in. It is said that Philadelphia, Washington and New York people have investigated the patents of Mr. Miller, and have invited him to visit their respective places, with a view of constructing and equipping a trial plant. The inventions consist of a complete system of street railway appliances, motors, underground trolley, rail and roadbed.

GENERAL APPLICATIONS OF POWER.

Indianapolis, Ind.—The Premier Steel Works is to install electric elevators throughout its large plant.

Electric Drills.—Eight new drills have been contracted for by the Poorman Mining Company, of Spokane Falls, Wash., through Mr. W. T. McCaskey, the agent of the Edison General Electric Company. These new electric drills will be put in operation at once.

LEGAL NOTES.

New Albany, Ind.—The Fort Wayne Electric Company has brought suit against the New Albany Light, Heat and Power Company for the recovery of property said to be unlawfully detained and $5,000 damages therefor.

The Burnley Dry Battery Patent.—A suit has been instituted against the Manhattan Electrical Supply Company of this city for alleged infringment of the patent of the Burnley dry battery.

Erie Telegraph and Telephone Company Sued.—Messrs. John Lowell, Charles H. Allen and W. H. Cadwell have begun a suit in Boston, Mass., for J. W. Bennett and Henry L. Tibbetts, of Lowell, against W. A. Ingham and others, known as the "Lowell syndicate" in the purchase and operation of the New England Telegraph and Telephone Company.

Lobbying Contract Contrary to Public Policy.—A person rendered services in "soliciting, advocating and procuring" the franchise for a municipal corporation to light its streets by electricity. The particular services performed were the canvassing of the city, getting acquainted with its aldermen, explaining to them the advantage of lighting by a certain system and asking them to advocate it if they thought it was for the best interests of the city. But it has long been settled that a contract to induce a public officer or member of a legislative body to do any official act is illegal and void. This opinion was given in the case of Wilbur vs. New York Electric Construction Company in the Superior Court of New York.

Edison vs. Welch.—Thomas A. Edison has scored a point at Boston, Mass., in the suit brought against him by E. Baker Welch, to recover $250,000 damages for alleged breach of contract, now pending in the United States Circuit Court. About a month ago the defendant filed a motion to have the plaintiff state more specifically on what patents he owns a half-interest under his contract. A further request was that the plaintiff produce certain letters and communications. Judge Nelson last week decided that the plaintiff produce the letters within 30 days, and also file a bill of particulars, settling on what patents, inventions, instruments and improvements he claims to have an interest. He is also ordered to state what inventions he has requested the defendant to transfer to him in which he says he has an interest.

Perkins vs. Edison.—A bill of complaint was filed last week in the United States Circuit Court by Charles G. Perkins, of Hartford, Conn., against the Edison General Electric Company, for damages for the infringement of a patent claimed by him. Perkins says that in 1881 he was the inventor of an improvement in circuit breakers for electric lighting. On the 4th of February, in that year, he filed his application for a patent, and one month later he assigned his right, title and interest in the patent to the United States Electric Lighting Company. In September, 1881, letters patent on this invention were granted to this company. On July 15, 1885, the patents were reassigned to him by the United States Electric Lighting Company, and since that time, although he has notified them that he is the owner of the patent, the Edison company has manufactured, used and sold a large number of circuit breakers, which is an infringement of his patent.

PERSONALS.

Mr. R. T. McDonald, manager of the Fort Wayne Electric Company, has just returned to Fort Wayne from an extended trip to New York and other Eastern States.

Mr. Henry M. Schearer, for several years with the Blue Line Railway Company of Rochester, N. Y., has become associated with the Western Electric Company of Chicago, Ill.

Mr. Charles Desmond, the editor of the *Stationary Engineer*, of Chicago, was in this city last week on his way to Boston, where he will spend about two weeks on a vacation trip.

Mr. F. G. Kurz, manager and electrician of the Edison Light Company, the Electric Street Railway Company and the Arc Light Company, of Appleton, Wis., will be married on Tuesday, August 11, at Oshkosh.

Mr. Robert Crawford, of the Testing Department of the Westinghouse Company, at Pittsburgh, and Mr. Francis P. Mann, of the Laboratory of the company, were among the visitors in New York City last week.

Mr. W. H. Patton, of the Patton Electric Car Company, while in the act of boarding a moving Illinois Central train at Pullman on Saturday slipped and fell, fracturing the radial bone in his right arm, dislocating his wrist and receiving several bruises.

Mr. James Bradley, general manager of the Phœnix Electric Manufacturing Company, of Massillon, O., was in New York City last week on business connected with the manufacture of incandescent lamps, which his company is about ready to take up and carry on extensively.

MISCELLANEOUS NOTES.

Electrical Engineering at Columbia College.—A circular of information has been issued by the Columbia College School of Mines which gives in detail the course of instruction arranged in the electrical engineering department of that institution.

"Electricity."—The first number of *Electricity*, "a weekly journal devoted to the advancement of electrical interests," made its appearance last week. The publication office is in Chicago Mr. W. H. Temple is the president of the company, Mr. H. S. Skillman the secretary and treasurer, and Mr. Irving Washington the business manager. The editor-in-chief is Mr. J. W. Dickerson, while Mr. Geo. H. Guy is the New York editor, the New York office being managed by Mr. C. McL. Paine, and the Boston office by Mr. W. S. Key. Messrs. Temple, Dickerson and Paine are ex-members of the staff of the *Western Electrician*, and Mr. W. S. Key has for some time constituted the editorial board of *Modern Light and Heat*. Mr. Guy is well known in New York as the secretary of the New York Electrical Society. The first issue of the periodical is a very creditable production. Its editors start out with the commendable intention of furnishing "the popular side" of electrical journalism, and they certainly deserve credit for the bravery they have shown in launching a new journal under the present conditions of the electrical newspaper market.

Electrical Cable Testing.—In the article on this subject by Mr. H. W. Fisher, in THE ELECTRICAL WORLD, July 11, the algebraical expression after formula (6) should be $\frac{a}{r_t} m$ instead of $\frac{a}{r_t} m$,—and formula (12) should be $\frac{t_{tt}}{t - t_t + t_{tt}} D$ instead of $\frac{t_{tt}}{t\, t_t + t_{tt}}$.

Contemporary Science Series.—A group of very valuable and interesting popular manuals of scientific subjects is to be found in the Contemporary Science Series of Scribner & Welford, of this city. Perhaps the best known of them to electrical readers is De Tunzelmann's treatise on electricity in modern life, but other valuable volumes are in preparation, among them one on the development of electromagnetic theory that should be especially acceptable at the present time. Of course in the series a wide range of scientific subjects is covered, the latest volumes, for example, being on the science of folk lore, modern bacteriology, and a very recent volume on education and heredity. Altogether it is a fine group of popular monographs, and the forthcoming electrical volumes we shall await with great interest.

Industrial and Trade Notes.

Mr. L. M. Moyes, formerly agent of the Babcock & Wilcox Company at 32 North Fifth street, Philadelphia, Pa., has surrendered the charge of the office and business at that point to Messrs. W. C. Temple and Henry F. De Puy.

The Electrical Forging Company, of 167 Oliver street, Boston, Mass., is meeting with unqualified success in its work so far

and has thoroughly demonstrated its adaptability in all kinds of forging, from the heaviest to the most delicate articles.

Messrs. Truex & Vail have just ordered 100 ammeters of the Walker Electric Company, and report the demand for the Walker specialties constantly increasing.

The Straight Line Engine Company, of Syracuse, N. Y., has just issued a fifth edition of its catalogue of engines, giving illustrations and descriptions of the various types now in use.

The Hine Eliminator.—In a competitive test at Sibley College, Cornell University, to determine the relative efficiency of steam separators, and in which test six separators of different makes competed, the Hine Eliminator, of New York, was awarded letter "B," the highest rank in order of efficiency for quality of steam above 90 per cent.

Sunbeams.—That "there are sunbeams and sunbeams" is clearly illustrated in the handsome circular Mr. J. H. Cooke, secretary of the Sunbeam Incandescent Lamp Company, is sending out, that bears the portraits of two very charming babies, whose rays of sunshine are doubtless brightening some home as efficiently as does the sunbeam lamp.

The Engineering Equipment Company, with offices in the Central Building, New York, and which deals in the very best material for electric light and power equipment, is as usual meeting with ready sales for the Anderson line material, the new Kellogg poles and Underwood belts. The Boston office, which is in charge of Mr. Magee, also reports a very active business.

Mr. Paul G. Burton will start Aug. 1 in the electrical supply business at Albany, N. Y., with headquarters at No. 464 Broadway, where he will have a complete assortment of electrical goods. He has had two years' theoretical education at Cornell University, besides considerable practical work. He has already received several important contracts in and around Albany.

The New York Insulated Wire Company has just issued a beautiful little pamphlet showing its system of interior conduits, together with a complete line of safety devices, junction and distributing boxes, joints and elbows. The conduits are manufactured from materials which are claimed to be absolutely moisture-proof and non-inflammable, thus guarding against leaking, fire, etc.

The Electric Merchandise Company, of Chicago, has secured the selling agency for Pratt's Portable Register for street car use. As it is considered by practical street railway men that this register is an excellent one, and as the company offers a number of inducements in the way of guarantees, large orders have been given, and a special department has been opened for the handling of this device by the company.

The Pond Engineering Company reports encouraging business from the Southwest. The company is building the complete power plant for an Edison central station at El Paso, Tex.; also a complete plant at Paris, Tex., for lighting and railway service. The Pond company is also furnishing Armington & Sims engines for Texarkana, Ark., and Austin, Tex.; the latter being for the new Capitol building—the second engine of this make now in the Capitol.

The Hall Railway Signal.—As is well known, no sensible person claims perfection in an automatic railway signal, but a dozen Hall signals on one particular piece of road show a record of seven and a half years without a single false indication, and so few unnecessary stops that the road keeps no account of them. This is not the result either of excessive time or money spent in the care of the signal system, as many roads which put in Hall block signals within the past year have had a similar success.

The McLean Engineering Company, of 136 Liberty street, New York, is installing a heating plant in connection with electric motors for pumping purposes at the residence of John S. McLean, Tarrytown, N. Y. This company has also furnished the power plant, consisting of McIntosh & Seymour engines, etc., for the East End Hotel, Rockaway, L. I., while Mr. Rockoff is installing the electrical equipment of 450 lights, using the continental incandescent system. The hotel, pavilion and numerous adjoining cottages will be lighted.

The Jewell Belting Company, of Hartford, Conn., is unusually busy for this season of the year. Among the recent installations are the Jamestown (N. Y.) Electric Street Railway Company; Springfield Electric Light Company, Springfield, Vt.; the Wautanga Lighting and Power Company, Johnston City, Tenn.; Cedar Rapids Electric Street Railway, Cedar Rapids, Iowa; a second order for a 48-inch double belt to the Toledo Street Railway Company; a 48-inch double belt to the Omaha Electric Street Railway Company; the Cohassett Electric Light Company; the Athol Gas and Electric Light Company, Athol, Mass.; and a second order from the Rockton Street Railway Company, Amsterdam, N. Y.

The Manhattan Electrical Supply Company, of 36 Cortlandt street, New York, is now offering to the trade a new dry battery. The cell is 2¼ inches in diameter and 6 or 7 inches in height from bottom to the top of the protruding carbon element. The cell is cylindrical in shape, with a central porous cup containing the negative element and a depolarizer surrounded by an exciting agent containing sufficient moisture to keep the battery in operation. The battery, it is claimed, has as long life as any open circuit cell on the market and has worked a 2¼-inch bell for 21 days through a resistance of 15 ohms. The Manhattan Company has adopted the admirable practice of replacing, at a small cost, exhausted cells with new ones.

Mr. J. M. Duncan, who so ably represents Messrs. Smith & Vaille, at 112 Liberty street, New York, with factories at Dayton, O., reports that his company is meeting with great success in the sale of its special pump for electric light purposes and that it has lately installed the same in electric light stations at Jersey City, N. J.; Richmond, S. I.; Scranton, Pa.; Elizabeth, N. J.; the Manhattan Company, Harlem Electric Light Company and the United States Electric Light Company, New York City; besides several of the Edison Illuminating Company's stations. An especially large installation was at the Somerville Water Works, Somerville, N. J., where two 2,000,000 gallon pumps are in operation. The factory of the company is now running night and day.

The Lieb Machine Works, of this city, has just closed a contract to replace with the new perfected Lieb trolleys, poles and stands complete, the 20 trolleys now in use upon the Jamaica & Brooklyn Electric road. This road has had one of the Lieb trolleys in constant use since early in March, and, although the wheel has been in use while the car has travelled nearly 8,000 miles, it is still working and in good condition. These wheels are guaranteed to make at least 5,000 miles, and it is thought that some of them will wear for more than twice that distance. The same company has also replaced with its new trolley head and wheel all the trolleys formerly in use upon the Flushing & College Point Street Railway. The first named road is using the Sprague system and the last is equipped with Westinghouse apparatus.

The Imperial Porcelain Works, successor to the Trenton China Company, of Mulberry street and Clagg avenue, at Trenton, N. J., of which Mr. Frederic A. Huggan is proprietor, has decided to manufacture insulating fittings for the electrical trade exclusively. The Imperial company is a pioneer in the manufacture of electrical insulation supplies, and has for years been known in the field of porcelain manufacture. The company's list of "Imperial" fittings comprises everything in the line of cut-outs, switchboxes, socket bases, etc., etc., and its line of insulators may be said to be one of the most extensive and best designed in the United States. Two new kilns have lately been added, and many improvements introduced throughout the works, so that the "Imperial" fittings may be expected to continue to grow more and more in favor with the electrical trade.

The "C. & C." Electric Motor Company has just issued a very handsome pamphlet containing a fund of useful information on the transmission of electric power. Among other things of value, it contains tables giving the rates charged for electric power in the following cities: New York, Chicago, Boston, Brooklyn, Rochester, Philadelphia, Des Moines, Cincinnati, Kansas City and New Orleans. A number of forms of contracts for motors and for electric power are given, and will prove valuable to all those engaged in the business of furnishing electric power to consumers. The pamphlet is supplemented by Mr. Lufkin's article on "The Proper Basis for Determining Electric Motor Rates," which was read at the Cape May meeting of the National Electric Light Association last summer.

Messrs. L. G. Wing & Co., of 126 Liberty street, New York, have just introduced the Regan gas engine to the trade, making a specialty of isolated plants. By the use of this engine it is claimed that they can furnish electric light at about 33 per cent. less than gas and give a much better light. The four h. p. engine only occupies a space of about 30 × 40 inches. It is strong and well-built, nothing but the best material entering into its composition, and no previous experience in running machinery being necessary to operate it. No attention is required after starting, as the oil cups hold sufficient oil for 10 hours, and the governing device is automatic in operation, regulating the consumption of gas to the amount of work being done. The ignition of the charge by means of an electric spark is claimed to render the operation of the engine safe, sure and reliable, and to entirely do away with all bad odors.

The Ticonderoga Machine Company, of Ticonderoga, N. Y., has recently increased its capital to $125,000, and has purchased new property in the vicinity of its old works, including a large addition to its water power. A five-foot iron trunk and turbine are now about completed, and a shop 144 × 80 feet. This shop is a model in convenience and equipment, and no pains or money have been spared to make it equal to any similar plant in the country. The Ticonderoga Machine Company, in addition to its other business, consisting of mining machinery, paper mill special machines, etc., will manufacture and sell the Woodbury engines, having perfected an agreement with the patentees by which the Ticonderoga Company becomes the sole licensee for New England, New York and New Jersey. The company has opened an office for the sale of its machinery at 126 Liberty street, Room B, New York, where Mr. W. B. Hammond, manager of sales department, will be pleased to attend to the wants of patrons.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Co., of 105 South Warren street, Syracuse, N. Y.

Delightful Resorts.—Our readers who are desirous of finding pleasant places to spend the summer should bear in mind that the Chicago & Northwestern Railway furnishes every facility for a rapid, safe and comfortable journey from Chicago to Waukesha, Madison, Lake Geneva, Neenah, Marquette, St. Paul, Minneapolis, Duluth, Ashland, Lake Minnetonka, Yellowstone National Park and the mountain resorts of Colorado and the far West. Fast vestibuled trains, equipped with reclining chair cars, parlor cars, palace sleeping and dining cars, afford patrons of the Northwestern every luxury incident to travel by a first-class railway. Excursion tickets at reduced rates and descriptive pamphlets can be obtained upon application to any ticket agent, or by addressing W. A. Thrall, general passenger and ticket agent, C. & N. W. Ry., Chicago, Ill.

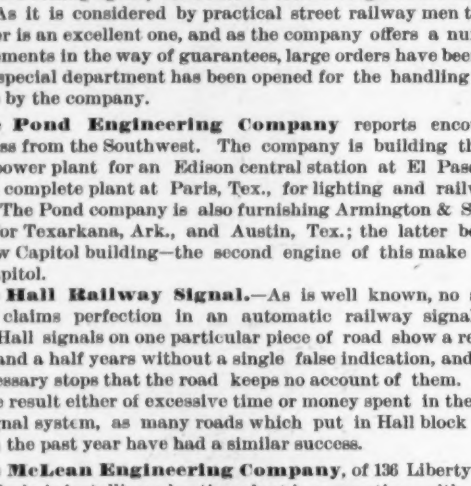
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JULY 21, 1891.

456,172. Method of Measuring Electric Currents; Elihu Thomson, of Lynn, Mass., Assignor to the Thomson-Houston Electric Company, of Connecticut. Application filed October 19, 1887. The method of measuring electricity, consisting in generating heat by the electric current, evaporating a liquid by the heat so generated, and noting the amount of evaporation to ascertain the amount of current that has passed through the heat generator. (See illustration.)

456,219. Electro-Therapeutic Apparatus; Edgar Grauert, of New York, Assignor to Emil Gramm, of same place. Application filed July 16, 1890. An electro-therapeutic apparatus, consisting of a portable case, a battery provided with a compressed plate of chloride of silver, devices for producing an interrupted current, and conductors leading from the case and terminating in electrodes on body band, said electrodes consisting of sliding clamps whereby they may be automatically held in any desired position on the body band.

456,250. Insulated Contact for Electric Switches; Ocron S. Platt, of Bridgeport, Conn. Application filed June 4, 1890. An electric switch consisting of a contact bar having a lip, contacts



No. 456,172.—Method of Measuring Electric Currents.

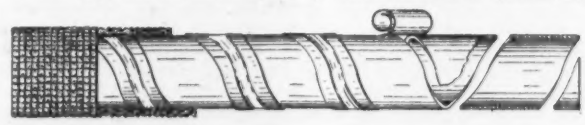
for the bar, a porcelain insulator having a slot, a brush mounted on the insulator, and filling affixing said insulator in place.

456,252. Connector and Support for Trolley Wires; Sidney H. Short, of Cleveland, O., Assignor to the Short Electric Railway Company, of same place. Application filed October 29, 1890. An insulating connector for sectional trolley wires, comprising a metallic frame formed with a trolley track, and having conductor-attaching devices and an opening between the same, in combination with conductor sections and heads or enlargements secured thereto, and to the conductor-attaching devices, and insulation between the conductor sections and the connector.

456,253. Operating Mechanism for Current Regulators; Sidney H. Short, of Cleveland, O. Application filed March 10, 1891. In combination with the current regulator, operating mechanism comprising a wheel provided with a web of non-conducting material, a chain, and connecting means whereby the said regulator is operated through said chain and wheel.

456,254. Switch for Electric-Car Motors; Sidney H. Short, of Cleveland, O. Application filed April 7, 1891. In combination with the wheel base of a car and four or more propelling motors, the rheostatic and commutating switches, the commutating switch being adapted to connect the motors in at least two of the three relations herein described—namely, series, multiple series, and parallel—and the rheostatic switch being arranged in a portion of the supply circuit common to said motors.

456,271. Flexible Conduit for Electric Conductors; Chas. H. Herrick, of Winchester, Assignor of two-thirds to Herbert H. Brooks, of Cambridge, and Alfred A. Brooks, of Boston, Mass. Application filed April 17, 1891. A flexible conduit for



No. 456,271—Flexible Conduit for Electric Conductors.

electrical conductors, composed of a spiral lining, a protective wrapping applied to cover the line of separation between the turns of the spiral of the lining, and an inclosing envelope. (See illustration.)

456,280. Rheostat; John Van Vleck, of New York, Assignor to Luther Stieringer, of same place. Application filed Jan. 19, 1891. In a rheostat, a series of contacts connected by resistances, another series of contacts also connected by resistances, and a switch arm or device co-operating with both series of contacts and arranged to throw a resistance of one series into circuit by movement of the switch one step and then to throw a resistance of the other series by movement of the switch a second step. (See illustration.)

456,325. Secondary Electric-Clock Movement; Benedikt Haberthür, of Breitenbach, Switzerland, Assignor of one-half to Pius Saner, of same place. Application filed Nov. 8, 1890. In an electric clock, a hand-propelling mechanism and electro-magnetic means for driving it, a striking mechanism, a motor spring therefor, and mechanical means in connection with said hand-propelling mechanism for rewinding said spring.

456,327. Cut-Out for Electric Lamps; Walter Francis Smith, of Philadelphia, Pa., Assignor to the United Gas Improvement Company, of same place. Application filed April 24, 1891. The invention consists of a lamp provided with a mechanical or spring-actuated switch or clamps, and with a filament having fusible pole pieces or terminal feet adapted to engage said clamps or switch.

456,376. Conduit for Electric Cables; Maurice Delafor, of Paris, France, Assignor to Jacob Frères & Co., of same place. Application filed August 15, 1890. A conduit of suitable insulating material having a removable cover, the joint between the cover and conduit following a broken line, whereby tightness of the conduit is assured, said conduit being also provided with a series of insulators, each having a groove, an insulating neck, flanges, and a lower support or foot attached to the body of the conduit.

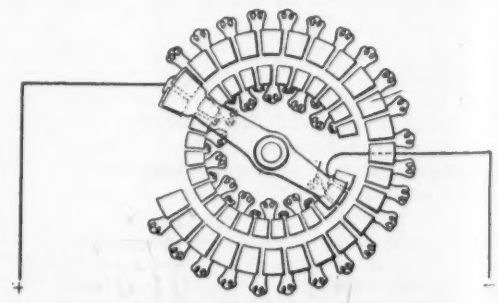
456,493. Double-Contact Switch; Thomas H. Lovell, of Cleveland, O. Application filed Dec. 2, 1890. In a double-contact switch, a fixed plate mounted upon a movable insulated spindle, having longitudinal movement in bearings at either end, and an operating pin, in combination with spring electrodes mounted on either side of the spindle, and provided with recesses adapted to receive and secure the rounded extremities of the plate.

456,507. Magnetic Separator; Henry G. Fiske, of New York, Assignor to John D. Cheever, of same place. Application filed March 26, 1891. The combination of a series of magnets of alternately-opposite polarity arranged radially on a rotatory shaft, a tubular shield rotatable freely around said magnets and independently thereof, a hopper for delivering ore or other material against said shield, and provided with an inlet for admitting air or water on the side opposite to said hopper, so that the current moves in the opposite direction to the feed of the materials under treatment.

456,513. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed July 14, 1885. The combination of an electric conductor extending along an electric railway, an electrically propelled vehicle, a frame supported by the vehicle and laterally movable, and an intermediate contact device supported thereby and independently of the conductor, but maintaining a traveling connection therewith and having a self-sustaining free swiveling movement about a vertical axis.

456,514. Electric Railway; Rudolph M. Hunter, of Philadelphia, Pa., assignor to the Electric Car Company of America, of same place. Application filed Sept. 23, 1886. In an electric railway, a main line and branch, each of which is provided with a positive and a negative conductor, and in which the positive conductors of the main line and branch are directly connected and electrically united without the employment of a switch, and in which the negative conductors are electrically connected and provided with a switch at their point of juncture.

456,540. Method of Welding by Electricity; John H. Bassler, of Myerstown, Pa. Application filed Aug. 16, 1888. The



No. 456,280.—Rheostat.

invention consists in first coating the meeting edges of the plates to be operated upon with carbon, then placing those edges close together, then sending simultaneously one current of electricity transversely through the joint from the upper surface of the plates and another current transversely through the joint from the lower surface of the plates, and moving the plates longitudinally with relation to the direction of said currents, in order that the line of joint may be subjected to the welding heat.

456,541. Method of and Apparatus for Electric Welding; S. Lloyd Wiegand, of Philadelphia, Pa. Application filed Dec. 9, 1889. The invention consists in the introduction of a fillet or strip of metal between the parts and in connecting such strip or fillet, so that the current and intense heat resulting therefrom may be concentrated upon a short portion in the seam, and to so heat the fillet of metal as to render it plastic and thus afford an easy means of enforcing intimate contact in the surfaces involved in the welding.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1866—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.